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THE UNIVERSITY OF ALBERTA

THE PREHISTORIC CULTURAL ECOLOGY OF THE WESTERN PRAIRIE-FOREST TRANSITION ZONE, ALBERTA, CANADA

by

© TIMOTHY C. LOSEY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
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DEPARTMENT OF ANTHROPOLOGY

EDMONTON, ALBERTA
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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "The Prehistoric Cultural Ecology of the Western/Prairie Forest Transition Zone, Alberta" submitted by Timothy C. Losey in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Anthropology.

Supervisor

Alan Lyle Bryan

A D Fisher

C.T. Shay

External Examiner

May, 1976

ABSTRACT

The Western Canadian prairie-forest transition zone is examined in light of the ecological concept of "edge effect" as a phenomenon which, because of ecosystemic overlap, accounts for increased species density and diversity. The prairie-forest "edge" or ecotone is then assessed in terms of its productivity and human carrying capacity as a prehistoric human habitat. After reviewing seasonal behavior patterns of several major animal resources found in the ecotone, historic seasonal game procurement patterns are examined with a view toward the relationship between hunting success and animal behavior which render these resources abundant and/or vulnerable to acquisition.

Five models for human adaptation to ecotonal environments are explored and a series of hypotheses are generated with which to perform a provisional test of their applicability to the prehistoric subsistence-settlement systems in the prairie-forest region. A test of predictions following from the five models is applied using a small sample of archaeological data from sites in the ecotone. The cultural assemblages are examined to determine (1) seasonal use or occupation of each archaeological component and (2) their possible cultural origin, i.e., plains vs. forest oriented society. The results of this preliminary assessment suggest that both plains and forest dwelling groups

utilized ecotonal resources on an alternating seasonal basis when discreet behavioral characteristics of certain game resources increased the level of abundance and vulnerability.

ACKNOWLEDGEMENTS

It has been my belief since the initial conception of this study some years ago that in order to begin a reconstruction and formulation of prehistoric lifeways of inhabitants of the western prairie-forest transition zone, a broad-based interdisciplinary approach would provide the greatest potential for the realization of my research goals. Consequently, my indebtedness for the completion of this initial statement is owed to a relatively large number of people of many interest areas and scientific disciplines.

Acknowledgement to my thesis committee must begin with Alan Bryan to whom, in 1968, I could give no good reason for not entering graduate studies at this University. Although his interests have since moved away from Alberta prehistory, much of the effort embodied in this study is owed to his initial encouragement. To David Lubell (my mentor) I owe much; for his encouragement and solice, and also lodging upon many-a-stormy night. I owe a great indebtedness to Clifford Hickey whose genuine interest in the study along with his doubts concerning its achievement, contributed considerable impetus to my efforts. I am equally grateful to Thomas Shay, Anthony Fisher and John Foster for their insightful comments and criticisms which have resulted in many improvements in the final product.

My efforts to delve into and comprehend fundamental

principles of ecology, upon which much of this paper rests, was guided among others by Charles Schweger, Thomas Shay, and Shirley Nalbach. Robert Ruttan, many years a guide and field wildlife biologist in Western Canada, gave freely of his time in working with me to assess the relationships of animal behavior to human hunting technology. Equally interested and always willing to share his knowledge is my friend and colleague Robert Janes, whose experiences among Northern Athabascan people have provided me with many valuable insights.

Funding for the field research embodied in this study has been received from a variety of sources including the National Museums of Canada, the Provincial Museum and Archives of Alberta, and the University of Alberta through research grants, bursaries, and various forms of financial assistantships. It goes without saying that without this assistance this effort could not have reached fruition.

Many students have contributed both their time and skills working beside me often without benefit of remuneration, to which I acknowledge my indebtedness. Omission of their names in no way demeans the value of the contributions.

Finally, to my wife, Jenny, for her patience with me, my ravings, and a growing family, is owed my greatest debt. To express it is perhaps unnecessary since, as in all things, we have shared the labor as well as the achievement.

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INTRODUCTION

Archaeological research in the transition zone between the Northwestern Plains and the southern Boreal Mixed-wood forest is hampered by a fundamental historical problem. That problem is the lacuna that exists in the ethnohistory pertaining to aboriginal inhabitants of the transition zone. The early expansion of Cree Indians and their allies into western Canada and the resulting displacement of aboriginal forest dwelling people is primarily responsible for this limitation. Since one of the goals of archaeology is to link the prehistoric with the ethnohistoric period, the gap referred to is one that must be dealt with if that goal is to be realized. Furthermore, until it is resolved, use of the direct historical approach to the prehistory of the transition zone is only partially useful.

There is abundant evidence that the prairie-forest transition was an important ecological zone with regard to human subsistence exploitation. Many of the aboriginal actors are absent or unidentifiable in early written records. The ecotone was strategic for wintering animals, such as bison and for the Plains Indian hunters following them. The transition was equally critical for the expanding fur trade economy in Canada as a provisioning zone where posts were built and country resources were pooled for support of the northern fur brigades (Ray 1971).

It is late in the 18th Century before adequate and reliable records concerning Native identities and lifeways are available. Thus, this study has been restricted to the use of published letters and journals (and they are numerous) which pertain specifically to the transition zone, its resources and people. This restriction may perhaps be criticized since much more material is undoubtedly available in Hudson's Bay Company, Provincial, and National archives. However, I submit that the picture gleaned from the documents consulted and studied to date is fundamentally accurate. Archival research certainly has value and may well add considerable detail to the findings of this study. Unfortunately such research cannot be included here.

In many ways, the time and direction of fur trade expansion into western Canada is very useful with respect to documentation of transition zone utilization. The fact that the North Saskatchewan River finds its course both central and parallel to the trend of the ecotone has resulted in a relative wealth of historical documentation for that area. The river forms a major and strategic highway which not only linked the interior with Hudson's Bay but encouraged the construction of trading posts within the west. This is a phenomenon which has been taken advantage of by concentrating on records which exist from the earliest possible moment and which represent the first impressions of aboriginal activities in a newly penetrated territory. The period is roughly the last quarter of the 18th Century.

The basic research design employed in this study follows the so-called "scientific cycle" (Kemeny 1959). The cycle is illustrated (Fig. 1) as a flow chart which makes explicit each of the fundamental procedures of scientific enquiry.

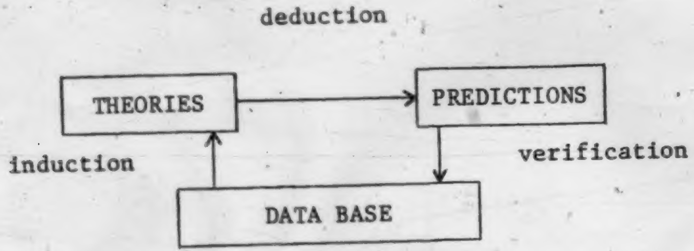


Figure 1. The Scientific Cycle (after Kemeny 1959)

The chart is useful in providing order for the data with respect to achieving the desired goals. The benefits of making these procedures (that is, induction/deduction/verification) explicit are amply demonstrated in Thomas' (1973) computer simulation of Great Basin Shoshone subsistence strategies and Fitzhugh's (1972) reconstruction of aboriginal cultural ecology of the Hamilton Inlet, Labrador.

Much of the data base is contained in Chapters I and II of this study. In Chapter I, the natural history or setting is characterized in two parts. First a detailed analysis of transition zone ecology is made; the physical make-up of the transition is explored; and the concepts of "ecotone" and "edge effect" are studied. Then the ecological principles of diversity, succession, and productivity are defined with an eye to explaining the nature of "edge effect".

Edge effect is defined as an increase in the relative variety and abundance of organisms at the juncture (edge) of two adjoining ecosystems. There are many complex mechanisms which are involved in the explanation of this phenomenon. Increased variety in animals, for example, has to do with the greater relative variety (mosaic) of habitats. Abundance of animals is undoubtedly linked to the resultant increased carrying capacity which is one of the postulated characteristics of the transition zone.

A select inventory of terrestrial, aquatic and avian fauna is also analyzed in Chapter I. Attention is given primarily to discussion of habitat and feeding habits, seasonal behaviour and social patterns, and the population dynamics of these animals. The selection of animal resources of potential importance to aboriginal populations is guided by two considerations: (1) ethnohistory, such as it is, provides a useful outline with respect to the animals present in the ecotone and their relative importance to human subsistence and survival; (2) the bones of animals are durable and thus are often recovered from archaeological sites, making knowledge of animals, their ranges and behaviour, a prerequisite to the goals of interpretation in this study.

Chapter II also presents a portion of the data base; but its source is history and ethnohistory. Two basic problems are dealt with in this section. First, a review of historical documents pertaining to the use of animal subsistence resources is conducted with the objective of reconstructing seasonal subsistence patterns as gleaned from the journals of fur traders.

European traders upon entering the frontier became, like the Native population, reliant on the vagaries of the hunt and the availability of country resources. Often too, Native hunters or Metis were employed as foragers. Thus it was hoped that some semblance of patterned hunting practices might appear intact in historic documents. Furthermore, it was assumed that if a procurement pattern emerged, it could probably be linked to behavioural characteristics which render these prey animals seasonally available, either through temporary vulnerability or by local increases in density.

The second problem dealt with in Chapter II is the role of aboriginal populations in the subsistence exploitation of the prairie-forest ecotone. Again, relying heavily on early documents such as letters and journals, it was hoped that references might be found to provide insight into the potential interplay between neighboring aboriginal groups within the transition zone.

The function of the transition as a wintering zone both for Plains Indian groups and the bison is clear. But since the forest dwelling population to the north was largely displaced by more recent Native immigrants, part of the picture is obscured. Reconstruction of the identity of aboriginal inhabitants of the southern boreal mixed-wood forest then became a necessary step in this exercise. The demographic dispersion and subsistence patterns of Blackfeet, Sarsi, Sekani, Beaver, Assiniboine, and Cree Indians are analyzed with reference to transition zone resources.

Using the information derived from ecology, natural history, fur trade, and ethnohistory, the study proceeds by induction (see Fig. 1) to the theoretical stage where models (hypotheses) are constructed, reviewed, altered or discarded with an aim to formulating a theory or model which accounts for the data base phenomena. These hypotheses are considered in Chapter III.

In formulating the models for ecotonal utilization, studies the Canadian to Carolinian Biotic Provinces in Michigan (Fitting 1966), Chippewa-Dakota relations in the deciduous forest transition zone of Wisconsin and Minnesota (Hickerson 1962), the adaptation of Illinois Hopewell to the riverine edge environment (Struever 1968), and the Great Basin Shoshoni piñon-juniper transition zone adaptation (Steward 1938), are reviewed. These real-world adaptive strategies are then explored for possible application to the Alberta prairie-forest ecotone. The predictions derived at this level are then tested using a small sample of archaeological material. The results will then be used to improve the model and/or testing procedure.

This critical step in the analysis is presented in Chapter IV where three archaeological sites are analyzed with particular reference to the faunal assemblages as possible seasonal indicators.

The interpretation relies, as it must, on information present in the data base. The cultural origin of the archaeological sites is also considered on the basis of presence or absence of certain diagnostic tools, materials, and features.

Chapter V operationalizes the verification procedure shown in the scientific cycle flow chart (Fig. 1). Here the results of the analyses are weighed to determine whether or not the model is verified by the analyses of archaeological data.

The data presented in support of a model for human subsistence exploitation of the western prairie-forest transition zone vary considerably in terms of accuracy, completeness, detail, and sophistication. Nonetheless, explanations can only account for observed phenomena no matter how complete or incomplete they may be. Early formulation of hypotheses not only helps to order data but may also enable the recognition of phenomena that were present but overlooked.

It is hoped that this study will provide a framework for future research in the transition zone that will not only seek to explain the trends and tendencies of its prehistoric inhabitants but will give direction to subsequent investigation and interpretation as well.

CHAPTER I

Part 1

DEFINING THE PRAIRIE-FOREST TRANSITION AND THE DYNAMICS OF ECOTONAL BORDERS

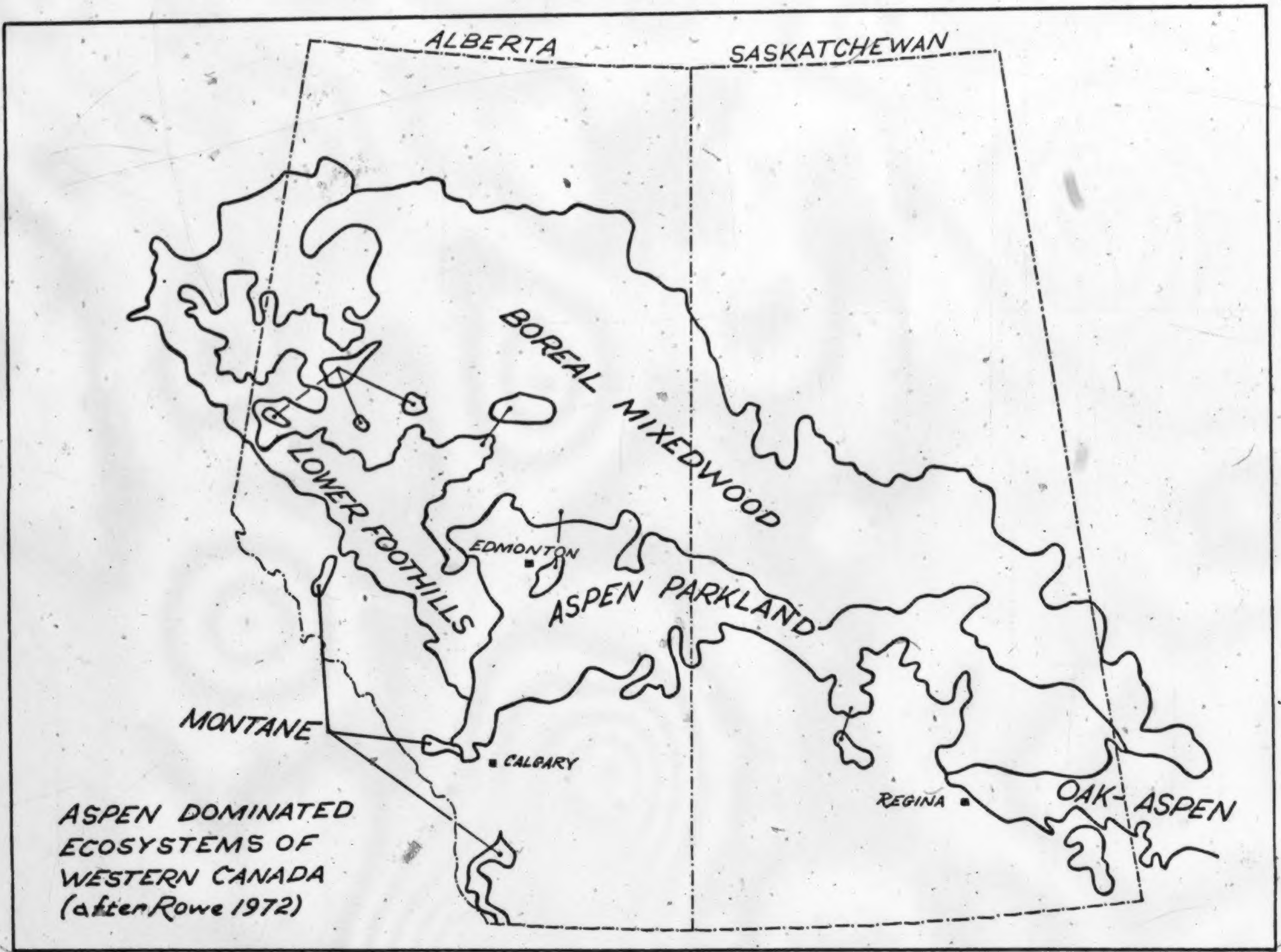
Boundaries of the Transition Zone

An important distinction should be made at this time between "Parkland" as a geographic area and "Parkland" as a specific physiognomic type. The Canadian or Aspen Parkland is also used to denote a geographic area which separates the northern plains from the mixed-wood forest. The term parkland is used as a formal classification for a plant growth form which ignores geographic parameters. The parkland as a vegetation type is defined as "patches of lower vegetation (parks) abundantly distributed over a continuous phase of forest or woodland" (Daubenmire 1968:251). To avoid confusion "transition zone" will be used to denote the geographic setting in this study.

The fact that there exists no clear-cut zonal boundaries either along or within the prairie-forest transition is evidenced by the numerous conflicting zones as mapped by various individuals using differing criteria. But precise boundaries are less important in a study of prehistoric subsistence economies than are the general dynamics of the environment itself. Furthermore, these boundaries can be expected to fluctuate through time and over space in response to major climatic variations. And, although it is recognized that any attempt to delimit precise boundaries would be counter-productive, it becomes a necessary evil in the effort to characterize its diverse nature.

The Canadian grassland/forest transition has been described by Rowe (1972) as the "Boreal Aspen forest region" of western Canada. It forms a broad northwest to southeast trending ecotone which extends eastward from and including the foothills of west-central Alberta, across south-central Saskatchewan where it veers southward into southern Manitoba. The Boreal Aspen forest region is characterized by the predominance of various species of popular (principally _Populus tremuloides_ and _P. balsamifera_ as well as pine and spruce). It is comprised of five separate zones or subregions. These are (1) Aspen Parkland, (2) Oak-Aspen Parkland, (3) Boreal Mixed-wood, (4) Lower Foothills, and (5) Montane zone (Fig. 2).

The southern portion of the Boreal Aspen forest (excluding the western foothills and southeastern most portions) is known as the Aspen Parkland. It is portrayed as a zone of interdigitation of prairie grassland and forest elements (Bird 1961), but lacking coniferous tree species. Zoltai (1975) has shown that the southern distribution of spruce and pine coincides remarkably well with the northern boundary of the Aspen parkland given by Bird. Zoltai (_op. cit._:11) used the distribution of five coniferous tree species to define a Parkland-Boreal forest transition zone.


ALBERTA
SASKATCHEWAN
BOREAL MIXEDWOOD
LOWER FOOTHILLS
EDMONTON
ASPEN PARKLAND
MONTANE
CALGARY
REGINA
OAK-ASPEN

ASPEN DOMINATED
ECOSYSTEMS OF
WESTERN CANADA
(after Rowe 1972)

Figure 2

Compared with Rowe's (1972) maps, the Parkland-Boreal forest transition identified by Zoltai (1975) falls within the northern Boreal Mixed-wood forest sub-region in Saskatchewan and Manitoba where the southern limits of white spruce coincide with the Boreal Mixed-wood/Aspen Parkland boundary. In Alberta, however, this transition zone lies almost wholly within Rowe's Aspen Parkland sub-region.

Portrayal of the Boreal Aspen forest zones as depicted in the _Atlas of Alberta_ (Anon. 1969) apparently bears little reality to the actual physical distribution of the arboreal species involved (_cf_. Zoltai 1975). It may be worthwhile to note that a _southern_ Prairie Parkland transition zone could no doubt also be defined on the basis of the northern-most distribution of certain grass species which would coincide with the "boundary" between the Prairie and Aspen Parkland.

The fact that different observers have described different vegetation zones and boundaries within the Boreal Aspen region serves to emphasize both the complexity of this extensive ecotone and the fact that clearly defined zonation simply does not exist. Moreover, it is apparent that the transition from grassland to forest is one of continuous gradation within which lesser vegetation "zones" may be defined depending upon the chosen parameters.

For the purposes of this study, the characteristics of the Aspen Parkland defined by Bird (1961) are adhered to with one exception. The ecotone as discussed here includes the northern

Parkland-Boreal forest transition zone (Fig. 3) formulated by Zoltai (1975). The reason for this is that by definition, an ecotone includes communities characteristic of ecosystems on either side joined in an interdigiting or mosaic fashion (Odum 1971; Daubenmire 1968; Carpenter 1935). Except for black spruce lowlands, the Aspen Parkland as described by Bird lacks most coniferous tree species represented in northern forest communities. Therefore, the prairie-forest transition zone must include not only the Aspen Parkland but the narrow zone along its northern boundary which is comprised in part by Boreal coniferous communities found in the Boreal formation.

The present day transition zone is an area bounded on the north and west by the North Saskatchewan River extending south to a line running east and west approximately through Red Deer, Alberta. Presently the transition zone is approximately 100 miles wide but was no doubt considerably less extensive in aboriginal times due to the presence of natural forces no longer extant, e.g., frequent fire, large herds of bison.

Characterizing the Transition Zone

The Aspen Parkland consists of forest and grassland plant communities intermingled in a patchwork of irregular isolated areas and more-or-less solid stands of each. Aquatic communities are numerous in the form of lakes and sloughs. The northern border of the parkland belt consists predominantly of popular, spruce and pine forest broken only by occasional isolated patches

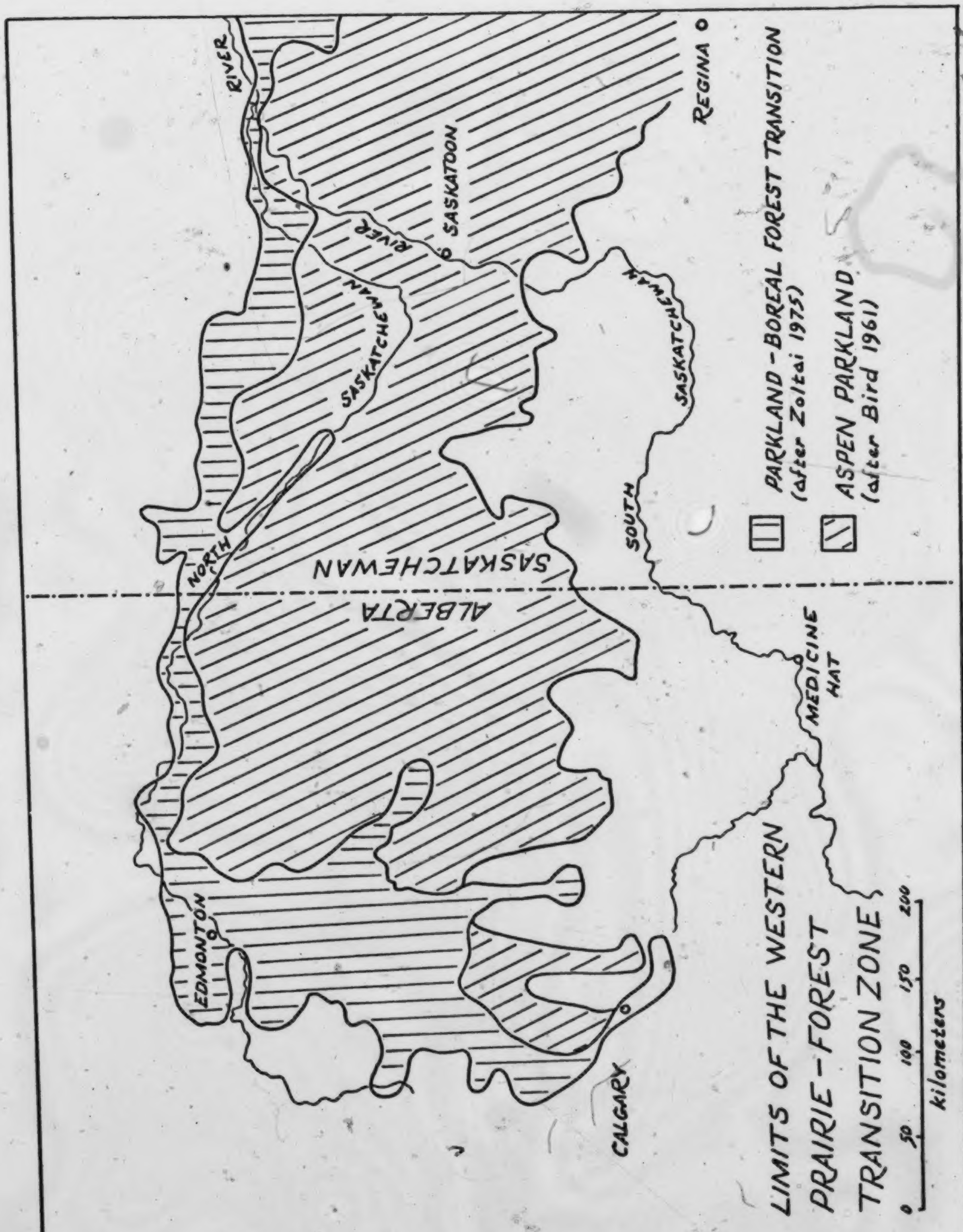

LIMITS OF THE WESTERN
PRAIRIE-FOREST
TRANSITION ZONE
0 50 100 150 200
kilometers
EDMONTON
CALGARY
ALBERTA
SASKATCHEWAN
NORTH
SASKATCHEWAN
RIVER
SASKATOON
RIVER
REGINA
SOUTH
SASKATCHEWAN
MEDICINE HAT
PARKLAND-BOREAL FOREST TRANSITION (after Zoltai 1975)
ASPEN PARKLAND (after Bird 1961)

Figure 3

of grassland. In the south, grasslands are dominant and aspen groves (forest) are isolated and sporadic responding to local moisture conditions and often found only on north and east facing slopes (Bird 1961:4).

The Aspen Parkland is a dynamic ecosystem responding frequently to pressures of fire, climate, and man. Periods of dryness or repeated fires where tree survival becomes tenuous, may cause the grassland to invade the forest. Similarly, the forest may advance during periods more favorable to tree growth (ibid:3). Comparison of early maps compiled by Seton (in Bird 1961:maps 1 & 2) indicates that the parkland boundary has advanced a considerable distance southward (about 70 miles) in the intervening fifty years. The magnitude of this expansion, however, is questioned by more recent work, particularly in the Manitoba region (cf. Zoltai 1975). The presence of mature black spruce in bogs which must have existed when Seton mapped the area as "Deciduous forest" creates some suspicion as to the accuracy of the alleged southern parkland boundary and therefore also, Bird's assumption (Zoltai 1975:9).

The southward movement of the Parkland zone is attributed by Bird to the infrequency of fires owing to more or less increasingly effective fire control measures which have accompanied western Canadian agricultural expansion. For example, many former prairie openings which occurred throughout the Parkland in Manitoba have been completely enclosed (Bird 1961:3 & maps 1 & 2).

The documented occurrence of fire on the northern grasslands of Canada from 1750-1900 (Nelson and England 1971) due both to "natural" (e.g., lightning) and intentional aboriginal burning practices clearly indicates that the role of fire is of major importance in the maintenance of the prairie grassland ecosystem; an importance which can certainly be applied to the adjacent Parkland.

Rowe (1972) also suggests that the predominance of popular (Populus spp.) in more northerly regions is due to frequent fires. Watt (1973:184-85) suggests that fire is an integral part of a system which maintains biological variety by starting the successional sequence over again. A detailed discussion of the dynamics of forest fire succession is contained in Schweger (1973), where the forest history of the Fisherman Lake area, Northwest Territories, is examined.

Fire might also be considered in the maintenance and/or renewal of aquatic communities by temporarily increasing surface run-off of water by removal of vegetation or by consuming woody plants such as alder and willow, which contribute greatly to the infilling of natural wet depression; and also by actually burning out the peaty deposits within a former wet depression during severe dry seasons, thereby restoring the contours of the basin and bringing it below the local base level.

Research on the effects of fire on rangeland (Hulbert 1969) indicates that the major short term benefits of grassland burning lies in the removal of litter rather than heat-induced nutrient changes.

Litter removal results in a lowering of soil moisture content by increasing the evapo-transpiration rate in summer thereby causing a lowered water supply for tree seedlings. This effect combined with the actual fire damage to seedlings prevents invasion of prairie by trees and is thus a major factor in the maintenance of natural grassland.

For the moment, suffice to say that fire most certainly plays an important part in both the occurrence and density of prairie openings as well as the predominance of popular in the Aspen Parkland. Snow cover, length of summer, terrain, and the presence or absence of chinook winds in winter are critical factors in the frequency and effects of fire in the Parkland region (cf. Nelson & England 1971).

Another factor to be noted in reference to the distribution of forest and grassland communities are the activities of large ungulates such as elk (Wapiti) and bison. Bird (1961:55) suggests that when elk are abundant they destroy all sucker growth from the aspen groves during winter browsing and that two years in succession will kill the seedling aspen and result in a predominance of grasses. The same is true of the Varying Hare. Similar behaviour attributed to bison which gives advantage to the grassland component is browsing on woody plants on the perimeters of aspen stands. Habitual head scratching and "horning" of both young and mature trees is also responsible for the destruction of forest elements (Allen 1967:60).

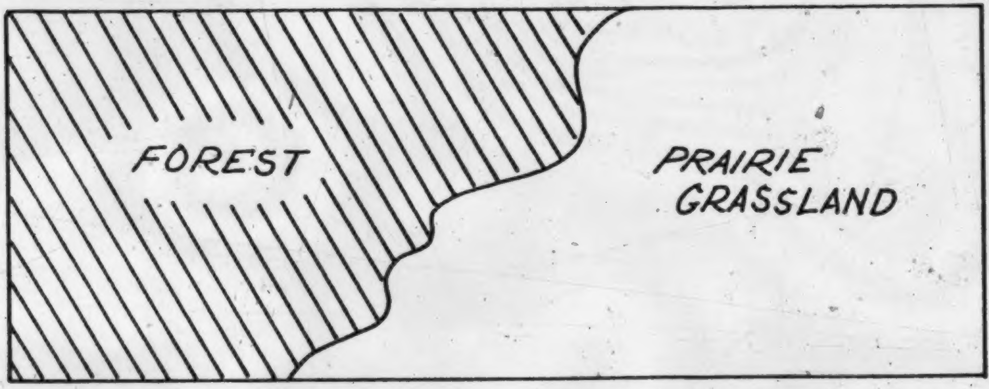
Ecotone and Tension Zones

Odum (1971:157) describes an ecotone as the transition between two or more diverse plant and animal communities. It is a junction or tension zone which may have considerable linear extent but is narrower than the communities flanking it. An ecotonal community commonly contains many of the organisms of each of the overlapping communities.

Bird's (1961) concept of ecotonal borders is in line with what may be referred to as simple ecotone. This includes (1) abrupt transitions resulting from abrupt discontinuities in environmental conditions; (2) abrupt transitions owing to the result of competitive plant interactions; and (3) transitions exhibiting a gradual blending of the two vegetation types which reflect a similar blending of two distinct factor complexes (Daubenmire 1968:18)(Fig. 4).

Daubenmire (op. cit.:22) describes a "mosaic" type of ecotone or transition zone which seems to characterize the Canadian prairie-forest transition very well. It is a transition between two vegetation units in which the latter interdigitate rather than merge by degree (Fig. 4c). A traverse across such a transition would reveal a decrease in peninsular or island-like areas of one type of community accompanied by a proportional increase in the other, until the latter forms an uninterrupted vegetation matrix.

This "mosaic" ecotone, in contrast to the simple type of ecotone (cf. Bird op. cit.) is more commonly a result of climatic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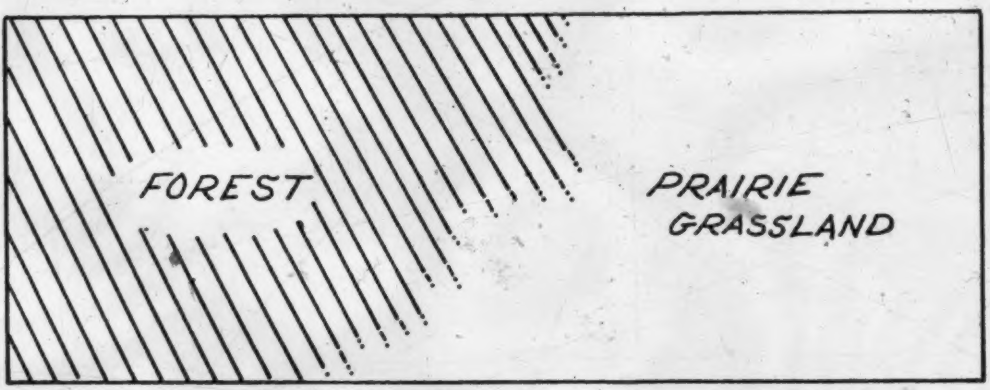
4a Abrupt transition resulting from environmental discontinuity.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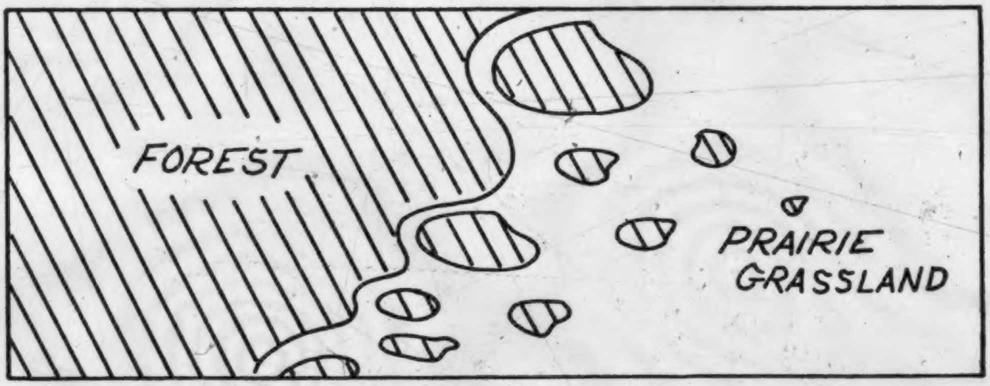
4b Gradual transition reflecting a blend of two distinct factor complexes.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4c Mosaic transition characterized by interdigiting island-like communities each true to type.

Figure 4 Variation in Ecotonal Boundaries

factors where one vegetation type is replaced by another. In this pattern each island-like community remains true to type; only the relative frequency of each community changes. Ecotones that are set by climatic and/or hydrologic factors are said to be the least immutable since their overall character depends directly on the course and rate of change in the factors controlling distribution. This category of ecotone is the only one which may properly be termed a "tension zone" (ibid:23; Odum op. cit.).

> Perfect adjustment of vegetation to ecotones of this category is so slow in comparison with the rate of climatic fluctuations that relics in varying stages of decadence are commonly found on both sides of the ecotone, and the transition belt would narrow if climate remained static. (Daubenmire 1968:23)

Daubenmire (1968:24) further argues that ecotones offer unique advantages for highly mobile animals; for example, large mammals in the form of mixtures of food plants (or animals) or in the presence of dissimilar vegetation types which satisfy alternate food needs. La Roi et al (1967:160) provides an example by pointing out that many of the mammals indigenous to the Boreal Mixed-wood forest region could not survive except for the "hybridization" of habitat provided by various agencies that set back successional trends because they may be dependent on one habitat for food and another for shelter. For Bird (op. cit.:4) the ecotone "occurs only around each grove of aspen within the zone".

Ecotonal Carrying Capacity and Edge Effect

> Often both the number of species and the population density of some of the species are greater in the

> ecotone than in the communities flanking it. The tendency for increased variety and density at community junctions is known as the "edge effect". (Odum 1971:157)

Edge effect is the phenomenon which accounts for both greater density and diversity of organisms in the ecotone. Unless the ecotone is very restricted, it can also account for certain habitats and organisms being present only in the ecotone. Those organisms which are most numerous or which occur most often in the ecotonal region are known as "edge species" (Odum 1971:158). Implicit in the concept of edge effect is the relatively greater supportive capacity of the ecotone as a mosaic of discrete habitats with regard to species density and diversity.

Carrying capacity as a concept is well established in both the field and literature of wildlife biology and has been used variously in range management studies but often with different meanings (cf. Sampson 1952; Mitchel 1941). The concept has, of course, evolved considerably from the single factor device first formulated by Leopold (1948:450) as ". . . the maximum density of wild game which a particular range is capable of carrying". Although not explicit, his definition relates only to food availability. A more modern interpretation is an attempt to both clarify and retain the utility of the concept which includes not only food availability but a consideration of quality of both animals and the range unit; the unavoidable fluctuations due to seasonal, climatic, and use patterns; and inter- and intra-specific interaction including competition, spatial tolerance, predation, etc.

In keeping with the systematic approach of more recent ecological studies (e.g., Margalef 1970), the definition presented by Edwards and Fowle (1955:597) seems to provide the greatest potential with regard to the problem at hand. They state:

> . . . we may regard carrying capacity as represented by the maximum number of animals of a given species and quality that can in a given ecosystem survive through the least favorable environmental conditions occurring within a stated time interval.

The "time interval" consideration is usually expressed in units of one year while an assessment at a given instant may be termed the "current carrying capacity" (_ibid_.). For muskrats or nesting ducks, water levels during the driest month may be critical. For larger animals such as deer or elk (_cf_. Flook 1970), late winter snow depths may affect foraging activities causing starvation, death or resorption of fetuses which in turn limits the population.

Carrying capacity with regard to the ecotonal situation constitues in part a measure of edge effect. It should be noted here, however, that the increase in density/diversity of organisms at a juncture is by no means a universal phenomenon and in fact the reverse may be true (Odum 1971:159). Such was precisely the case in a study of historic and prehistoric human settlement patterns at the juncture of the Canadian and Carolinian Biotic Provinces in Michigan (Fitting 1966:146-47).

Edge effect and carrying capacity as presented here are considered closely linked ecological phenomena. Statements concerning the potential for human population growth can hardly be separated from a quantification of the carrying capacity for the particular area in question. The limitations and effects of the human carrying capacity will, of course, vary with the level of technical development possessed by the human population concerned.

Assuming that the concept of edge effect can be applied to the ecotone surrounding each community within the transition zone as well as to the mosaic ecosystem itself, it can be postulated that the phenomenon will be "maximized". Maximization of the edge effect within the prairie-forest transition then is certainly a direct expression of an increased carrying capacity as far as organisms which inhabit the ecotone are concerned. If this is accepted the prairie-forest ecotone can be considered a "special" environment with regard to the potential ways in which a prehistoric human population might exploit it. The seemingly endless variability of human subsistence practices would make such an environment particularly attractive. Theoretically, a human population, whether adapted permanently or only seasonally to the ecotonal resources of the prairie-forest zone, would indeed have the best of two worlds.

Summary-Discussion

The Boreal Aspen forest region is a broad ecosystem which exists throughout central Alberta and Saskatchewan, and southern

Manitoba. The southern portion of this region is occupied by the Aspen Parkland belt. The Parkland is described by Bird (1961) as an intermingling patchwork of forest and grassland communities. Conifers, however, are excluded from his definition of the Parkland. More recent work in the region (Zoltai 1975) has identified a relatively narrow belt referred to as the Parkland-Boreal forest transition which lies intermediate to the Aspen Parkland and the Boreal Aspen forest. For the purposes of this study the prairie-forest transition will include communities of both the Parkland belt and the Parkland-Boreal forest transition.

The application of the concepts of edge effect and carrying capacity to the prairie-forest transition strongly suggests that this zone should possess especially high potential regarding human resource utilization. The carrying capacity of the ecotone (particularly regarding food animals) is assumed high due to the maximization of edge effect due to the occurrence of both the simple ecotone and the mosaic tension zone. It is assumed therefore that species variety and density is greater not only within the broad context of a prairie-forest ecotone but also at the borders of the insular communities which comprise it.

It has been stated that the simple ecotone or "forest edge" assumes great importance wherever man has modified the natural setting (Odum 1971). By extension, the act of either "natural" or intentional burning, has an equivalent effect. The importance of fire as a major force in this and other ecosystems is apparent both by the recent expansion of the southern Parkland boundary and the closure of former prairie openings. Fire is also important as a means of setting back normal successional stages, thereby maintaining a high level of productivity for certain game animals.

The prairie-forest ecotone has the potential of providing abundant food resources found in the southern prairie grasslands and in the northern deciduous coniferous forests. Human groups normally adapted to exploitation of faunal and floral resources in either of the overlapping ecosystems are "pre-adapted" to life in the ecotone. Furthermore, additional resources not available in the adjoining zones might be procured simultaneously. As well, these resources may vary across the transition zone. However, a human population possessing a subsistence strategy that can be applied in the ecotone, has the potential advantage of exploiting many of the major resources of the adjacent ecosystems within the narrow zone of overlap. But to further this discussion is premature as ecotonal subsistence-settlement models are examined in detail in Chapter III. The characterization of important animals, their densities, distribution, and population dynamics is presented in the next section.

CHAPTER I

Part 2

THE DISTRIBUTION OF RESOURCES IN THE ECOTONE

In the examination of habits and habitats of a selection of animals known to have ranged in the prairie-forest ecotone, particular reference is given to (1) food types of known importance to the aboriginal subsistence base and/or (2) those that are represented in the archaeological data base. Among the terrestrial mammals are included moose, Wapiti, deer, buffalo, and hare while the aquatic animals examined are the beaver, muskrat, and waterfowl. Several species of larger fishes which may be considered important potential food resources are also examined. These include trout, grayling, goldeye, whitefish, perch, pike, sauger, sturgeon, Dolly Varden, and tullibee.

Wapiti (Cervus canadensis spp.)(Fig. 5)

Wapiti or "elk" is often referred to in the journals of early explorers and traders as 'red deer'. The term 'elk' was originally applied to the European equivalent of the moose (Alces alces) (Banfield 1974). Five subspecies are recognized which separately inhabited eastern Quebec and southern Ontario, the prairie provinces from southeastern Manitoba to Peace River district in Alberta, eastern British Columbia, and Vancouver Island (ibid.: 401).

The subspecies which inhabited the prairie-forest edge was probably _C_. _c_. _manitobensis_ or the prairie form characterized by its darker color and smaller antlers. This variety now only exists in a few national parks. One other variety, _C_. _c_. _nelsoni_, is said to have ranged in the Rocky Mountains of southwestern Alberta and in eastern British Columbia as far north as the middle Liard River region (_ibid_.).

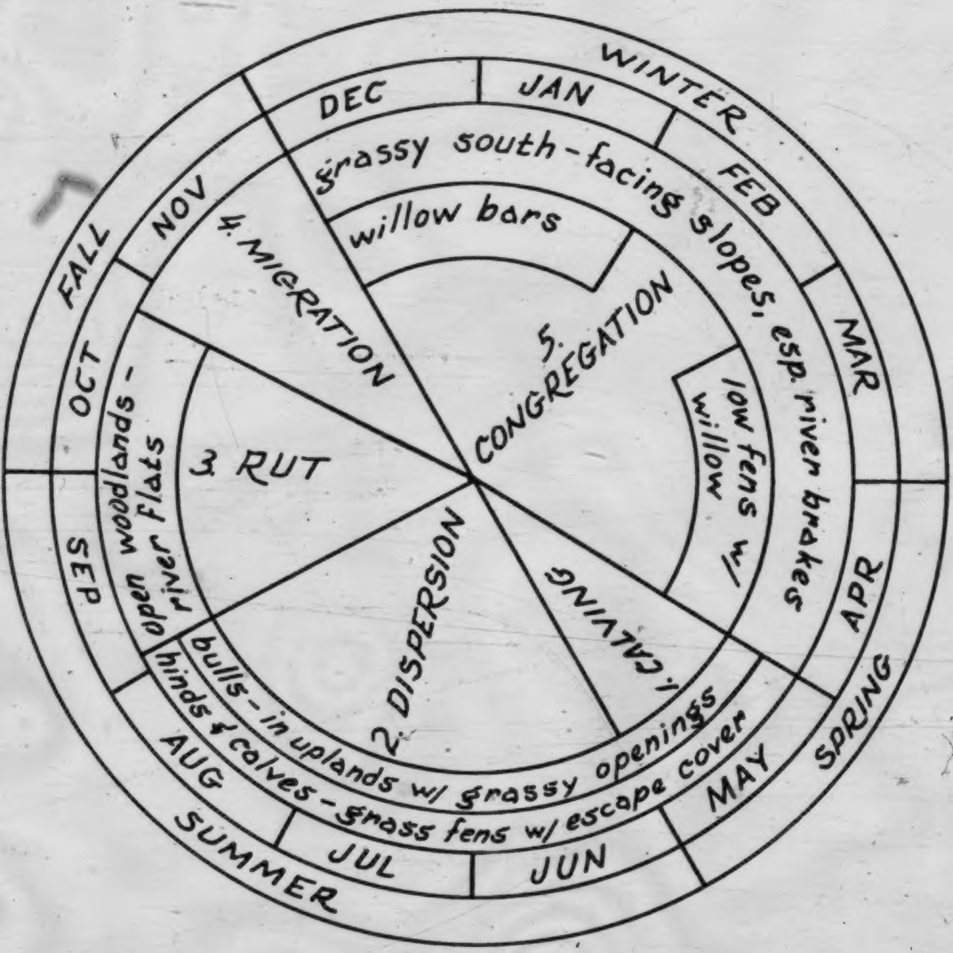
The population dynamics of Wapiti (_C. canadensis_) have been extensively studied by Flook (1970) who has elucidated the sex distribution, natural mortality, and seasonal physical and biological behaviour of populations in several large national parks. The male to female sex ratio in natural populations of Wapiti based on census and slaughter data from several areas is on the order of 1:3 (Flook 1970:56). At birth, however, this ratio is usually about 1:1 or even slightly in favor of males. By the time the animals reach two years of age, the sex ratio swings in favor of females and remains fairly stable (that is 1:3) from 2 to 7 years old. The initial shift in the sex ratio is related to the habit among 2 to 3 year old stags to move away from their home range (_ibid_.:20-21).

Although both males and females experience a period of negative energy balance from December through April, the total energy requirements of the female are lower (due in part to smaller body size) giving them a somewhat greater survival advantage. The bulls, in addition to entering winter in poor condition, often move to winter range in marginal habitats (with deeper snow in mountainous regions) which reduces pressure on the hinds and sub-adult animals while also reducing chances of survival among the older males (ibid.:58-59).

Beginning with the May calving season, the hinds move from their winter range into grassy fens near water and close to dense escape cover in which to hide their calves. The bulls prefer uplands with adequate escape cover and grassy openings from May through August. Old burns and areas of deadfall are used extensively for bedding by both sexes (Ruttan personal communication).

The rut, which begins in September, normally takes place in open areas such as along river flats or in sparsely wooded, hilly country. Throughout November the Wapiti migrate to their winter range which is generally located on grassy, south facing slopes in hilly country or river breaks where snow cover is reduced. Depending upon the severity of weather, they may remain there throughout winter or until the snow becomes crusted. In early winter (December-January) thick stands of willow (*Salix interior*) found on mid-river islands, are often extensively browsed. If snow becomes crusted in late winter (March-April), the Wapiti may move into bottomlands to forage in grass fens and willow brush (ibid.).

The weight of stags averages 700 (590-1,120) pounds while the smaller hinds average 495 (419-600) pounds (ibid.). Figure 5 summarizes the salient behavioural characteristics which affect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grassy south-facing slopes, esp. river brakes
willow bars
low fens w/ willow
5. CONGREGATION
1. CALVING
2. DISPERSION
3. RUT
4. MIGRATION
bulls-in uplands w/ grassy openings
hinds & calves-grass fens w/ escape cover
open woodlands - river flats

Fig. 5 Seasonal behavior of Wapiti affecting local densities and sex-age distribution.

1. Calving season commences in May. Hinds separate from herds and move off to calve.
2. Hinds and calves form bands of ca. 25 animals and occupy summer range. Stags also form bands which disperse in autumn.
3. Stags separate and compete for small herds of hinds for duration of the rut.
4. Animals "migrate" toward winter range. Vertical movements in mountainous areas are well known.
5. Herds of ca. 100 animals of random age and sex distribution form for duration of winter. Herds are matriarchal.

(after Banfield 1974)

the density and distribution of Wapiti. Those factors in turn play an important role in their availability as a resource to man.

Mule Deer (Odocoileus hemionus)(Fig. 6)

Three subspecies of mule deer are recognized: *Odocoileus hemionus columbianus*, *O.h. hemionus*, and *O.h. sitkensis*. They range from southwestern Manitoba to the west coast of British Columbia (including Vancouver Island) and north from the International Boundary to Great Slave Lake and the Liard River system (Banfield 1974:389, map 167). The variety *O.h. hemionus* is common throughout the prairie provinces and is the characteristic deer of the mountains and foothills of western Canada. Mule deer have a peculiar stiff-legged bounding gait which has resulted in the common name of "jumping deer" (*ibid*.).

Population dynamics and behaviour of mule deer are much less well known than for the eastern white tailed deer. These characteristics must, therefore, be obtained by analogy.

In a controlled January deer hunt in Illinois, Roseberry and Klimstra (1974) have computed the sex ratio in a large herd of white tailed deer at 58:100 in favor of females.

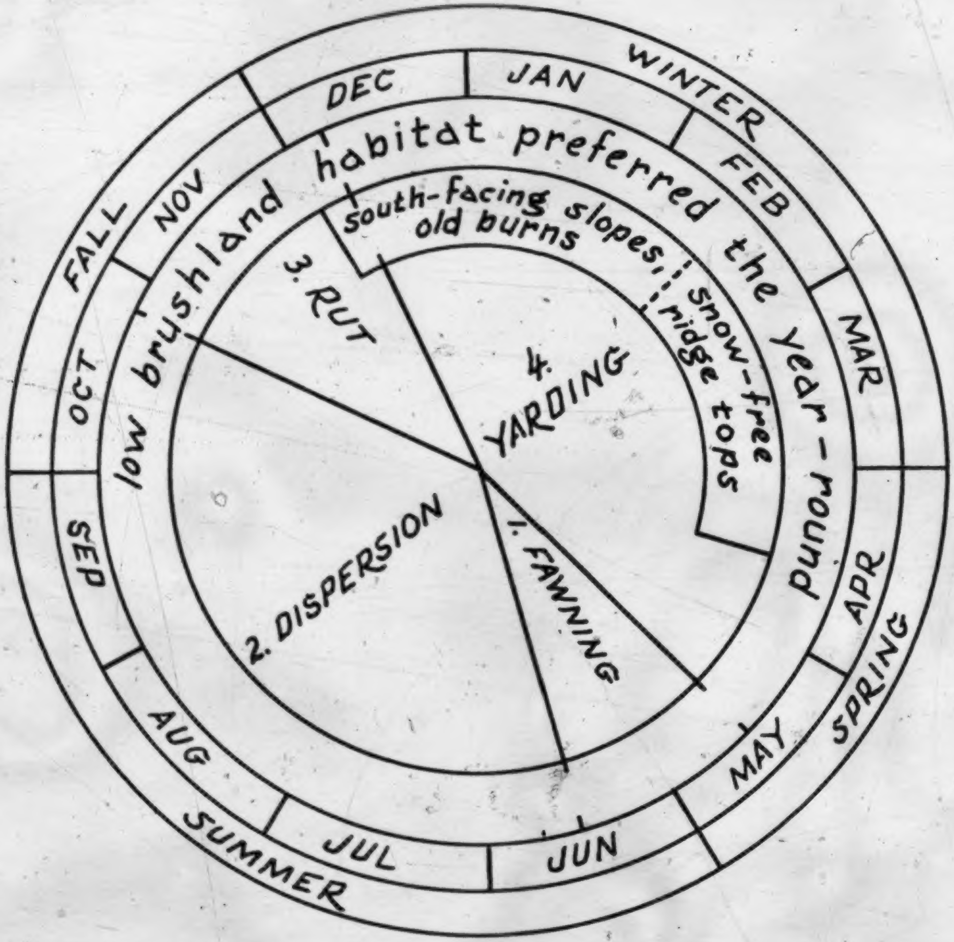
The results of the deer hunt suggests marked differences in vulnerability with respect to certain sex-age classes which are of interest in the present study. During the first days of the hunt, 1.5 to 2.5 year old males were harvested at an initial rate of 52.8% of the total kill. This was followed by a decline so steep that in five days the proportion of deer taken in this class was less than any other group harvested. Bucks older than 2.5 years were taken in significantly fewer numbers suggesting that these individuals were more wary than the younger class. Another factor thought to influence the vulnerability pattern is the transient nature of the younger age class in seeking new home ranges (ibid.:504-505).

Generally mule deer prefer low brushland to wooded country or grassland throughout the year. With the onset of snow, these animals are commonly found on south facing slopes in hilly country or along river breaks, or in open burns until snow becomes deep enough to inhibit movement. When this occurs, ridge-tops blown free of snow are favored wintering areas (Ruttan, personal communication).

Adult male mule deer average 293 (110-475) pounds while females average 115 (70-160) pounds. Figure 6 indicates seasonal behavioural features which affect distribution and density characteristics of the mule deer. The data are drawn primarily from Banfield (1974).

Moose (Alces alces spp.)(Fig. 7)

The moose, often referred to as the "original" in early journal writings, is the largest member of the deer (Cervidae) family. In Canada it is represented by three subspecies believed to have originated during the last glacial maximum in refugia in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low brushland habitat preferred the year-round
south-facing slopes, old burns
snow-free ridge tops
3. RUT
4. YARDING
1. FAWNING
2. DISPERSION

Fig. 6 Seasonal behavior of mule deer affecting local densities and sex-age distribution.

1. Fawning occurs in late spring to early summer among individual does. Twins are common if winter range is adequate and animals are in good condition.
2. During summer the deer form independent bands of one sex; band size is variable.
3. The rut extends from late October through early December with a peak during the first three weeks.
4. Winter behavior is characterized by congregations known as yarding. Herds of large size and mixed sex-age classes occur.

Alaska, the mid-western United States, and along the Atlantic sea-board (Peterson cited in Kelsall and Telfer 1974). The variety *Alces alces andersoni* occupies the northern half of the three prairie provinces and southward along the foothills in Alberta (Banfield 1974:397). Like other large ungulates, moose populations have undergone considerable change in distribution and reduction as a result of excessive hunting pressure following white colonization (*ibid*.).

Moose prefer a forest habitat less than 50 years old and often increase in numbers with the growth of deciduous trees and shrubs following fire (Kelsall and Telfer 1974:122). Of the wide variety of browse utilized, willow appears to be the preferred food along with birch and aspen. Moose require on the average five pounds of browse per hundred-weight (Banfield *op*. *cit*.:396).

Climate is an important factor in the distribution of moose. Winter snow in excess of 60 centimeters makes travel difficult (Kelsall and Telfer *op*. *cit*.). Snow density, hardness, and duration may also be critical limitations. Extreme cold does not apparently effect moose populations to any great extent, although in areas where temperatures exceed +27°C without shade or water refugia, they do not thrive (*ibid*.:125).

The cow moose, beginning with the May calving season through mid-summer (July), prefer wet lowlands or large lakes where aquatic plants provide the major food resource and water provides escape from insects and predators for both cows and calves.

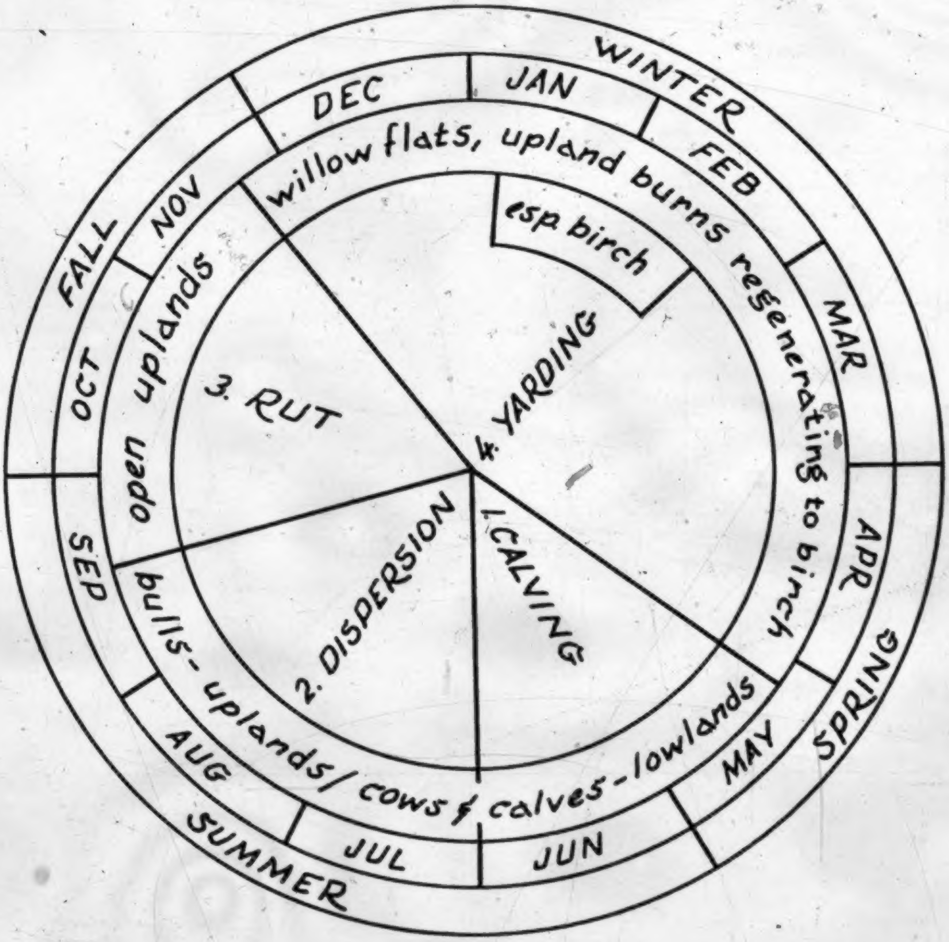
During this same period, bulls occupy upland areas where there is adequate drinking water nearby. Often, the cows and calves abandon the lowlands in mid-summer to browse succulent new growth in the forest understory (Ruttan, personal communication).

In winter, bottomland willow flats or upland burns regenerating to birch (Betula sp.) are favored habitats. The latter is often preferred mid-winter range when extreme cold renders the birch brittle and easily broken down for feeding (ibid.).

Average weight among male moose is 1,000 (847-1,177) pounds and among females is about 768 pounds (Banfield 1974:395). Figure 7 portrays seasonal variation in behaviour which affects differences in local density and distribution of moose.

Buffalo (Bison bison spp.)(Fig. 8)

Probably more has been written on the North American bison (Bison bison) than any other big game animal on this continent, but behaviour studies in their natural state by biologists are rare due to the early devastation of bison populations. The bison is the largest of North American terrestrial mammals. Its former range in Canada extended from eastern Manitoba to eastern British Columbia, and northward to the Peace River and Great Slave Lake districts. Two subspecies are recognized; the plains form B.b. bison which also inhabited the eastern woodlands of the United States, and the larger, darker, "woods" form known as B.b. athabascae (Banfield 1974:408).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willow flats, upland burns regenerating to birch
esp. birch
open uplands
bulls - uplands / cows & calves - lowlands
1. CALVING
2. DISPERSION
3. RUT
4. YARDING

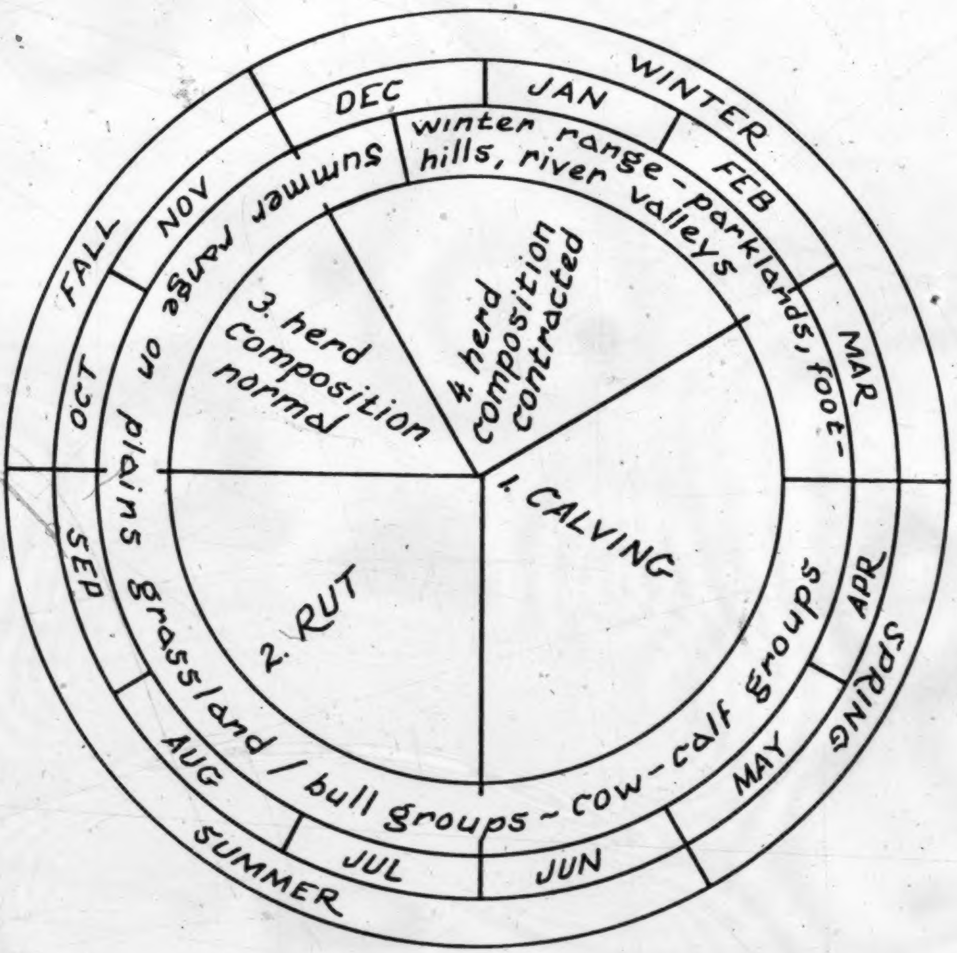
Fig. 7 Seasonal behavior of moose affecting local densities and age-sex distribution.

1. Calving normally occurs throughout May and June when yearling calves are driven off. Calves are born in seclusion and twins are common.
2. Moose remain solitary throughout summer and group feeding is accidental. A strong pecking order is usually apparent.
3. The breeding season is two months long during which the bulls exhibit typical rut behavior. Cows are the vocal sex during this season and hunters may attract bulls by mimicking the female call.
4. Winter normally requires yarding when food resources become limited due to snow cover.

In spite of the relative wealth of historic documents pertaining to the behavioural characteristics of bison, conflicting opinions are often evident. The former notion that bison migrated annually over a vast range from Mexico to the northern plains of Canada has been dispelled (Roe 1970). It is now thought that seasonal migration probably does not exceed a distance of 200 miles and often much less.

Bison are habitually diurnal; feeding normally begins at dawn and continues intermittently until dark. There are longer rest periods of two to three hours after noon, during the heat of the day (Banfield 1974:405). In winter, rest periods are short or nonexistent owing to shorter daylight hours (Soper cited in Arthur 1974:40). Nearness to water does not appear to be a critical range requirement as bison will travel several miles to drink or can apparently do without for protracted periods (ibid.). In winter, snow takes the place of water.

Bison have well developed senses of smell and sight. They possess three gaits including a walk, trot, and gallop; the latter carrying them along at speeds in excess of 30 miles per hour and they can easily out-distance a horse. Bull bison attain an average weight at maturity (six years) of about 1,200 pounds, while cows average over 900 (Banfield 1974:405) and consequently could attain somewhat greater all out speed (Arthur 1974:46). Arthur (1974) has reviewed much of the pertinent literature on bison behaviour, the primary features of which are summarized in Figure 8.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winter range - parklands, foothills, river valleys
summer range on plains grassland / bull groups - cow-calf groups
1. CALVING
2. RUT
3. herd composition normal
4. herd composition contracted

Fig. 8 Seasonal behavior of bison which affect local densities and sex-age distribution.

1. Calving normally extends from March through June with a possible peak in April. At calving time the herd is composed of bull groups and cow groups which may also include males younger than four years. Gestation is 270 days.
2. The rut may commence immediately following calving season from June through September with a peak in mid-August. Bull groups dissolve to mingle with cows. Herd size thus increases and composition shifts. Bulls become truculent and unpredictable.
3. In fall the herd resumes a normal group composition.
4. December through February, herds move into contracted areas along wooded river valleys and prairie fringes.

Varying or "Snowshoe" Hare (*Lepus americanus*) (Fig. 9)

The varying hare, *Lepus americanus*, is a member of the large family *Leporidae* which collectively possess a continental distribution in North America. In Canada, its habitat encompasses nearly the entire country with the exception of the barrenlands, the coastal islands off British Columbia, and the Cypress Hills of Alberta (Banfield 1974:84, map 38). In many regions it represents the greatest biomass of any mammal.

The hare is typically crepuscular and nocturnal throughout the year. During daylight hours it remains concealed with the aid of color camoulflage pelage which is brown in summer and white in winter. With nightfall, the hare moves over an intricate maze of well established trails to feeding areas within its domain (Banfield 1974:81). Its activity is governed by light intensity and so, is often seen foraging in the open on cloudy winter days. Unknown to many is the fact that hares are good swimmers and may take to water to avoid predators. The sex ratio among hares is approximately 50:50.

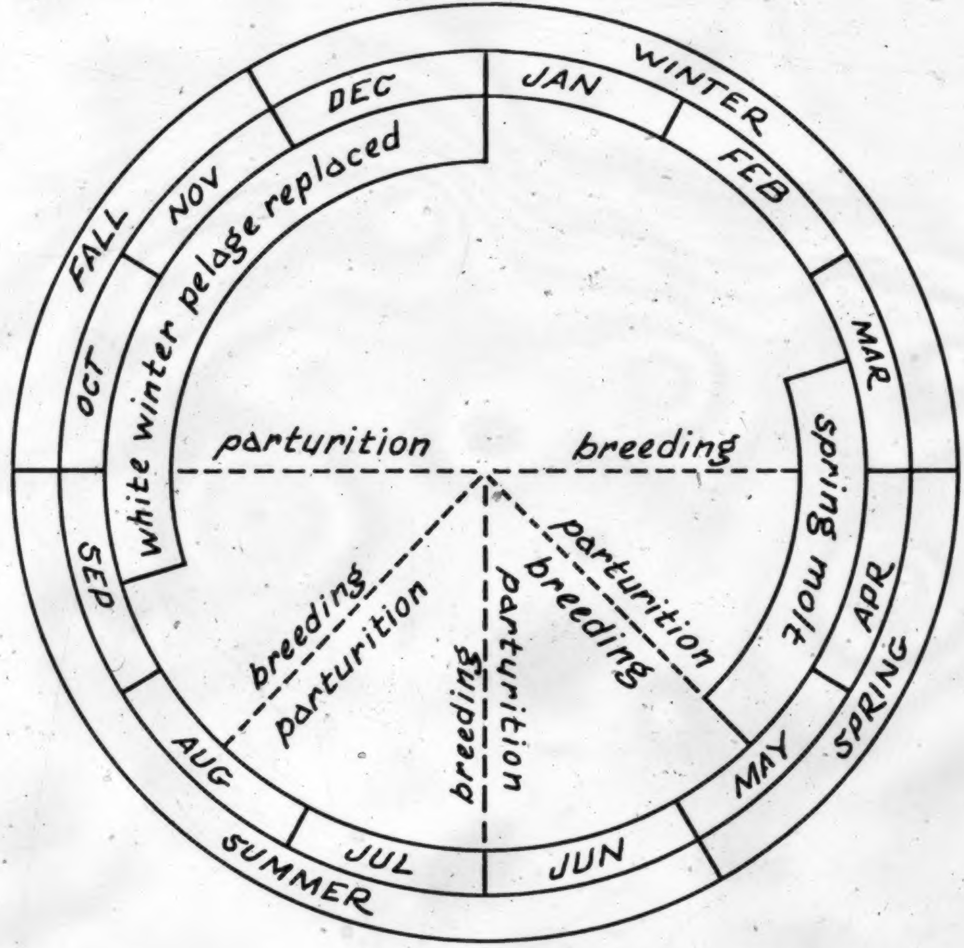
One of the best known and most regular examples of the ten-year cycle phenomenon pertains to the hare; since this animal occupies an important place in the food chain between plant producers and carnivore consumers (*ibid*.).

A recent study of hare in Rochester, Alberta by Meslow and Keith (1968) has shed much light on their population dynamics and reproduction cycles. It spans a six year period during which a peak, decline, and partial population recovery was documented. A population decline from 622 to three hares per square mile was recorded. The observed trend was province-wide (Meslow and Keith 1968:812). The decrease was marked by a decline in the survival rate among adult animals to 13%, followed by an increase to 28%. Juvenile survival rates rose from 3% to 10% and again to 24%. Litter size, pregnancy rate, and the presence or absence of a fourth litter increased progressively as the animals recovered from the population crash (ibid.). The factors affecting the hare population decline were summarized as follows: (1) a halving of the reproduction rate, (2) a substantial decrease in adult survival, and (3) a juvenile mortality rate from birth to the following spring of 97% (ibid.: 831).

Adult male hares in Alberta average about 3.1 pounds, whereas adult females weigh significantly more at 3.4 pounds. The breeding cycles and pelage changes of the varying hare are summarized in Figure 9.

Beaver (Castor canadensis)(Fig. 10)

The distribution of beaver in Canada extends from coast to coast with the exception of the barrenlands, high alpine ranges, and south central Alberta. Nine subspecies have been recognized. Numerous accounts have been written beginning with the earliest explorations of Canada. The beaver had a long history in North America beginning in the Pleistocene with the giant 700 to 800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white winter pelage replaced
spring molt
parturition
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parturition
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parturition

Fig. 9 Seasonal behavior, breeding cycles and pelage changes among varying hare which may affect hunter vulnerability.

1. Breeding commences in early spring (April) and is repeated three to four times during the summer season. Breeding occurs immediately after parturition. Gestation is approximately 60 days. Males especially vulnerable due to increased range and activity during breeding.
2. The molt of white winter pelage commences in mid-March and lasts 72 days. Early disappearance of snow cover may make the hare particularly vulnerable to predators.
3. The replacement of summer coat with white winter pelage commences in mid-September and continues through December. Late winter snowfall can also make the hare conspicuous and vulnerable.
4. Nine to ten year population cycles account for hare population densities fluctuating widely. Variation from as few as one to as high as 3,400 individuals per square mile have been noted (Banfield 1974). Both sexes are easily trapped due to their habit of using well established trails.

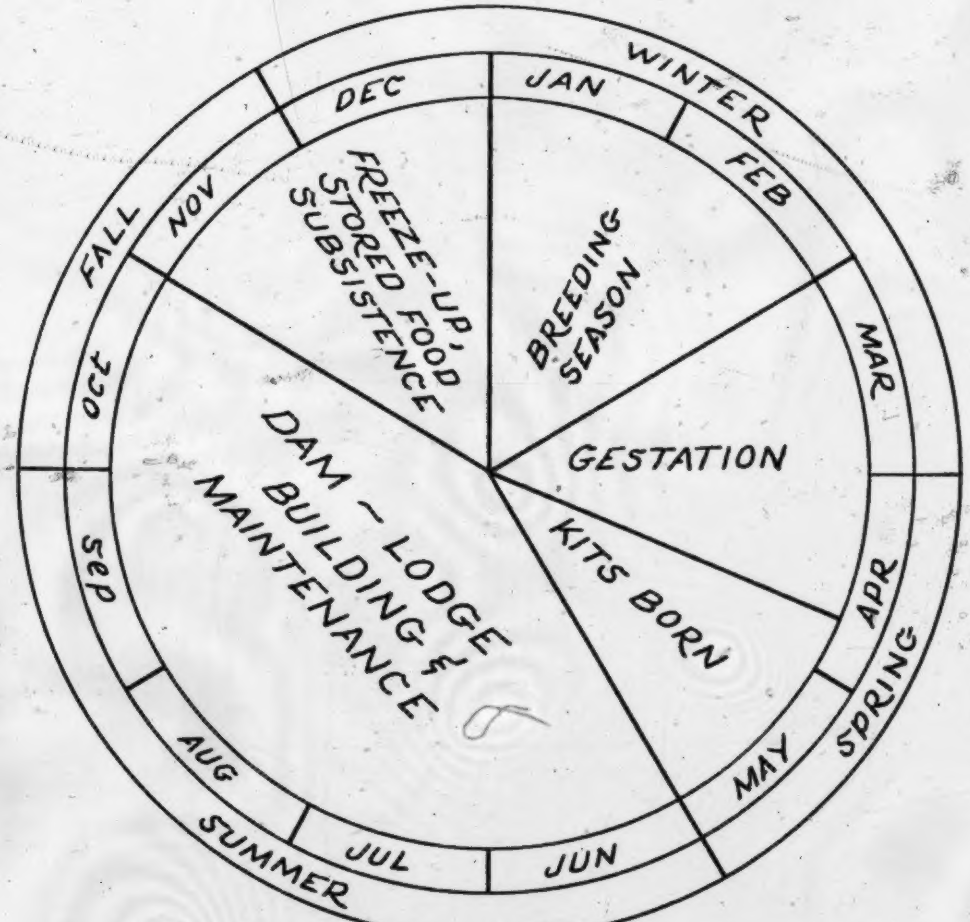
pound C. castoroides now extinct (Rue 1964).

The common behavioural traits including the construction of dams, lodges, and feeding channels are so familiar no additional elaboration will be given here (see Rue 1964; Banfield 1974). The activities of beaver seem to be directed towards maintaining a sedentary existence as long as possible. Additional dams or heightening of existing ones serves to bring food resources into proximity of the ponds by raising the water level; thus reducing the risks from terrestrial predators. Through the habit of dam construction, beaver not only actively defer the normal development of local drainage systems but may create habitats for many other important animal resources; among them muskrat, waterfowl, and moose.

The weight of adult beavers is highly variable but the average is about 44 (33 to 77) pounds (Banfield 1974:158). Of importance to this study are the population dynamics and density characteristics which affect the beaver's abundance and availability as a food and fur resource. The breeding and working cycle of the beaver is summarized in Figure 10.

Muskrat (Ondatra zibethicus)(Fig. 11)

The muskrat is an amphibious rodent and is the largest member of the microtus family. Like the beaver it is a sedentary animal which inhabits water bodies usually not less than four feet in depth. Its range in Canada is identical to the beaver, and it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KITS BORN
DAM - LODGE BUILDING & MAINTENANCE
FREEZE-UP, STORED FOOD SUBSISTENCE

Fig. 10 Seasonal behavior and working cycle of beaver.

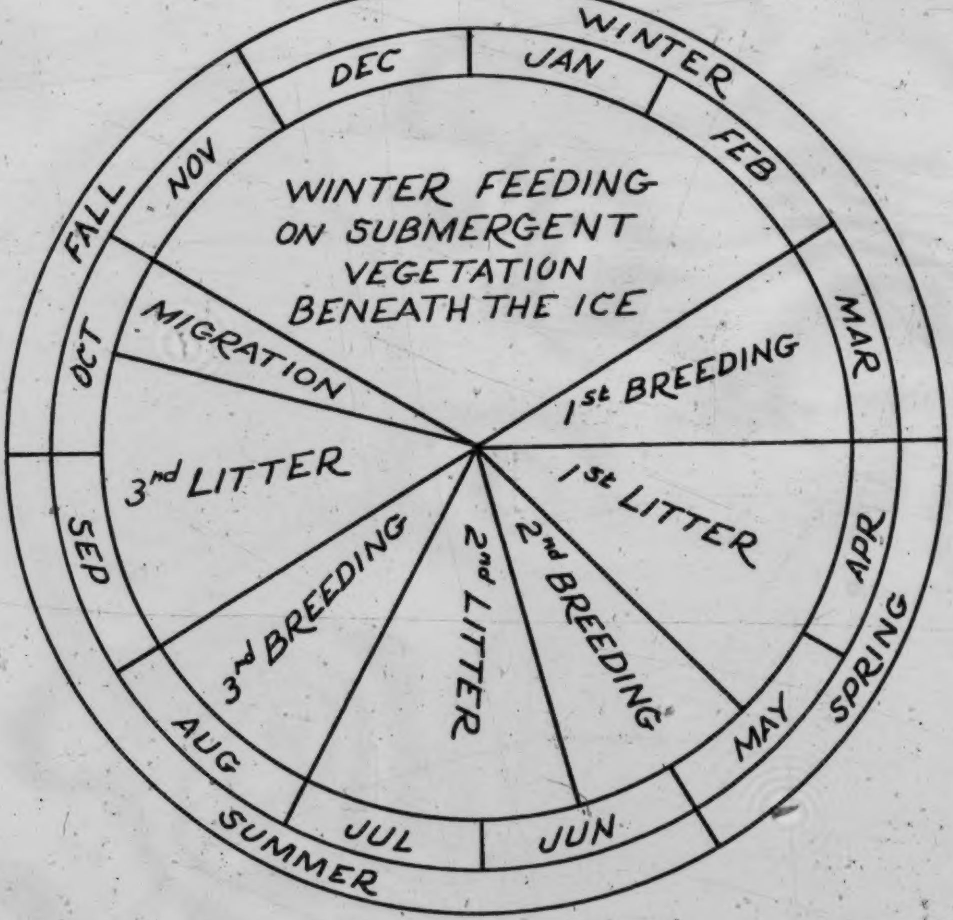
1. Kits are born in a litter averaging from one to eight in late April through May. Males and juveniles vacate the lodge at this time. Sexually mature offspring are driven off to form new colonies.
2. Family group consists of adult male, female, and one- and two-year olds who contribute to construction and maintenance of the colony.
3. Upon freeze-up the beaver family remains active but subsists on stored food.
4. Breeding season extends through January and February. Gestation is 3.5 months.
5. Beaver are vulnerable to man in winter when more or less restricted to the lodge and immediate surroundings; and also in spring when young adult beaver are forced to establish new colonies.

often inhabits beaver ponds in a kind of commensal relationship (Banfield 1974:198).

Muskrats characteristically live in family units similar to that of the beaver. They construct two types of structures: the house and the pushup. Houses are usually constructed on a stable object such as a log or a large feeding platform. Pushups are winter feeding stations which are maintained by breaking or gnawing through the ice and constructing a porous dome of submergent vegetation.

Feeding activity among muskrats is greatest during twilight hours and after dark. Typically they feed on a wide variety of both emergent and submergent aquatic plants. Horsetails (Equisetum sp.) are seasonally preferred and is the only food which is stored (Fuller 1951:18). Feeding takes place on a definite "platform" or area to which the muskrat returns repeatedly.

While muskrats may fall prey to any number of aquatic and terrestrial predators, the fact that, like the hare they sometimes carry tuleremia, is an important consideration since this disease is extremely dangerous to man. Keith (1963) has indicated that the muskrat probably responds to a ten year cycle very similar to hare populations and hence, their population dynamics may also be comparable. The breeding and working cycle over a one year period is presented in Figure 11 in a generalized form.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1st BREEDING
1st LITTER
2nd BREEDING
2nd LITTER
3rd BREEDING
3rd LITTER
MIGRATION

Fig. 11 Seasonal behavior and working cycle of muskrat.

1. Initial breeding among muskrats is March or April depending on conditions. Two to three litters from two to seven kits each are produced. Fuller (1951:37) gives an average litter size of 8.7 per northern Alberta.
2. Migration, usually of males, occurs in fall when sub-optimal habitat is abandoned. Many fall prey to predators. Houses are heightened for winter.
3. With appearance of permanent ice, push-ups are constructed to maintain breathing-feeding areas along lines radiating from the houses. Subsistence through winter is on submergent vegetation.

Waterfowl (ducks: family Anatidae)(Fig. 12)

Millions of permanent and ephemeral potholes and sloughs located in the southern portion of Alberta, Saskatchewan and Manitoba constitute a habitat in which 47% of the North American duck population breeds each year. As a result, the prairie wetlands of Canada form the site of what may be called the North American "duck factory". Crissey (1969) estimates a continental population average of nine million mallard ducks per annum over the period from 1955 to 1966.

Annual production of a wide variety of ducks is related to climate and, in turn, to the density of suitable breeding ponds. In a normal year , the prairies as a whole may give rise to an average of as many as 30 potholes per square mile (Stoudt and Gollop cited in Kiel et. al. 1972:35). However, total water surface available is not so important as the total area of suitable breeding-nesting habitat.

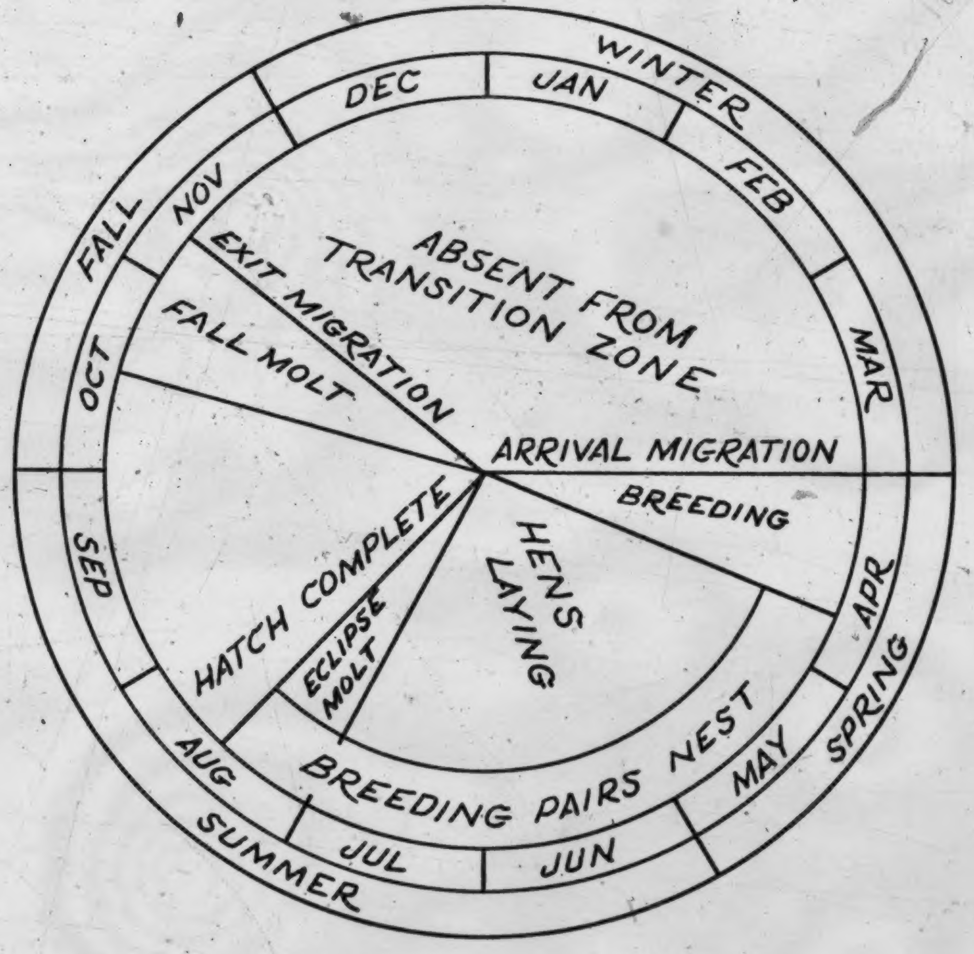
During drought years, nesting sites may become so scarce that a large portion of the duck population may over-fly the prairie-parkland breeding area and spend the summer in northern Alberta and the Northwest Territories (Crissey 1969:162). While adult ducks summer quite comfortably in northern areas, the production of broods is greatly reduced (ibid.).

A predominance of mallards (25% of the total duck population) is due to their ability to re-nest in the event of initial nesting failure (Smith 1969:118). An increase in pair density results in migration of some breeding pairs to marginal habitats thus reducing overall productivity (Dzubin 1969:156). Figure 12 indicates the annual nesting migration and flightless periods for most common waterfowl.

Although fish as a food resource is poorly represented in the archaeological sites to be dealt with later in this study, their importance in the subsistence base of the aboriginal population should not be underestimated. Table 1 summarizes the life histories and physical characteristics of one important species which are native to the study area. These data are included here more for future reference than for its applicability to the current problem.

Estimates of Maximum Sustained Yield

Determining the maximum sustained yield for populations of animals is perhaps one of the most complex problems in modern applied ecology (Kendeigh 1961:207). Obviously a yield or harvest cannot exceed the net production of an organism without depleting the standing crop. Productivity is a fundamental property of all populations of organisms, but the level of productivity varies inversely with increasing population density. An understanding of this concept must include an appreciation of (1) what constitutes a normal population growth curve, and (2) the regulatory mechanisms which keep a population in check.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EXIT MIGRATION
FALL MOLT
ARRIVAL MIGRATION
BREEDING
HENS LAYING
HATCH COMPLETE
ECLIPSE MOLT
BREEDING PAIRS NEST

Fig. 12 Seasonal behavior (migration, nesting, and molt) among waterfowl common to the transition zone.

1. Waterfowl migrating from southern wintering areas may begin to appear in April depending upon weather conditions.
2. Hens nest and begin to lay eggs in late April and are finished by early June. Clutch size diminishes as summer approaches.
3. The summer or "eclipse" molt occurs in mid-summer while breeding pairs are still nesting. Birds may become flightless for several days.
4. By mid-August hatching of broods is complete.
5. Late fall is the final molt preparatory to exit migration south to wintering areas.

Table 1

Distribution and Physical Characteristics of Major Fishes in Alberta
(Taken from Scoll and Crossman 1973)

Species	Size Rnge/ Inches	Wt Rnge/ Lbs	Max Wt/Lbs	Age Rnge/ Yrs	Spawning Season	Food Habit	Distribution
Cutthroat Trout *Salmo clarki*	12-15	1-10	41	4- 7	Spring (Feb-May)	Predaceous	Headwaters-Saskatchewan and Athabasca Rivers
Rainbow Trout *Salmo gairdneri*	12-18	6-10	17	3- 4	Spring (mid-April-June)	Salmon roe, invertebrates, insect larvae	Peace and Athabasca Rivers
Grayling *Thymallus articus*	12-15	2- 4	5.9	5- 6	Spring (April-June)	Zooplankton, invertebrates, insects	Holarctic to C. Alberta
Goldeye *Hiodon alosoides*	12-15	—	2.1	6-10	Spring (May-July)	Multifarious	Central and low N. Saskatchewan R.
Lake Whitefish *Coregonus clupeaformis*	c 15	c3- 5	24	15-16 max	Fall (Nov-Dec) earlier North	bottom feeders invertebrates small fishes	Deep lakes Central and North Alberta
Mountain Whitefish *Prosopium williamsoni*	8-12	—	4.5	17-18 max	Late Fall/ Early Winter	bottom feeders esp. insect larvae small molluscs	Large lakes, head-water rivers, lg streams
Yellow Perch *Perca flavicens*	4-10	c¼- 1	2.25	9-10 max	Spring (mid. April - 1st May)	Fish, roe, insects, large invertebrates	Circum polar/ large rivers
Northern Pike *Esox lucius*	18-30	4- 5	55	10-12	Spring April-May)	Carnivorous	Throughout Canada
Sauger *Stizostedion canadense*	10-16	c 2	8.5	13 max	Spring (L. May-E. June)	Small fish, insects, invertebrates	N. Saskatchewan R.—northern limit in Alberta
Sturgeon *Acipenser fulvicens*	36-60	10-80	234	50-80	Spring (E. May-L. June)	Indiscriminate bottom feeder	Large lakes, North Saskatchewan River west to Edmonton
Tullibee *Coregonus artedii*	8-12	3- 4	8	4- 5	Fall (Oct-Nov)	Basically plankton feeders	Lakes throughout east & central Canada
Walleye pike *Stizostedion vitreum*	13-20	1- 3	23.5	c 3	Spring (L. April-June)	Insect larvae, mayflies, carnivorous-cannibalistic	Throughout Canada
Dolly Varden *Salvelinus malma*	12-18	—	14.8	10-12	Fall (Sept-Nov)	Insects, snails, leeches, salmon roe	Headwaters from S. Saskatchewan-Liard Rivers

Population Growth Curves

Population growth curves are constructed by plotting density over time. They take one or two basic forms: either the "J" or the "S" (sigmoid) form (Figs. 13,14). The "J" curve represents a type of growth form common to lower organisms which occur seasonally. For example, insects reproduce rapidly to a ceiling imposed by the environment which is then followed by an abrupt truncation or a steep population decline (Odum 1971:183). The "S" curve is representative of population growth that proceeds at a fairly even rate up to some ceiling or upper limit (asymptote) at which equilibrium is established (birth balances mortality). This equilibrium level is a constant function of the environment which is denoted as the "K" and is often referred to as the carrying capacity (ibid.).

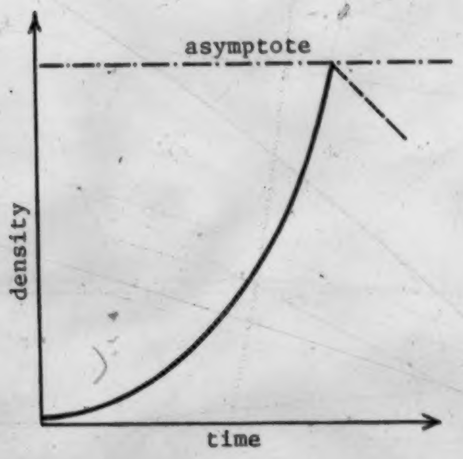

Fig. 13 J-shaped growth curve (after Odum 1971:184 Fig. 7-10)

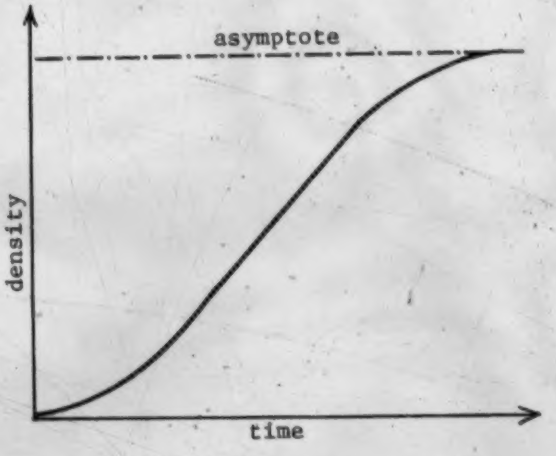

Fig. 14 S-shaped growth curve

Odum (op. cit.:185) has suggested that populations of higher organisms which possess complicated life histories and long developmental periods respond less quickly to environmental perturbations. These more complex organisms often overshoot the upper asymptote which results in a series of population "oscillations" above and below the "K".

Population Ceilings

Traditionally, food has been viewed as the primary factor in the natural control of animal populations (cf. Lack 1954). Other research (e.g., Wynne - Edwards 1971) suggests that genetically selected social behaviour may be more important through regulation of breeding success. Odum (1971:197) suggests that populations not only avoid suicidal density levels, but evolve toward ". . . regulating their density at a level well below the upper asymptote".

Regulatory Mechanisms

What then are the regulatory mechanisms which control natural populations? Population control mechanisms are usually referred to as either extrinsic (density-independent) or intrinsic (density-dependent). Ecologists have given more attention to the influence of density-dependent factors in the natural regulation of animal populations than to its counterpart (Kendeigh 1961:220). Density-dependent factors are intrinsic or "biological" in nature and are most often thought of as one of the chief agents in preventing overpopulation (Odum 1971:196). In diverse "benign" ecosystems three features concerning population regulation which stand out are (1) the importance of density-dependent factors, especially selflimiting intraspecific competition, (2) stability in density patterns, and (3) the importance of biological control mechanisms (ibid.).

Population Cycles

Oscillations in the population density of an organism with regard to the environmental carrying capacity can be understood in terms of regulatory mechanisms pertaining to the achievement of an equilibrium level. Cyclic variation above and below the upper asymptote are the result of "lag" due to the longevity of larger animals. For many species, the density oscillations are regular and predictable, and both 3 to 4 year and 9 to 10 year cycles have been recognized (Kendeigh 1961:238; Keith 1963). Two points concerning the behaviour of cyclic small game animals should be noted: (1) "cyclic species tend to persist in scattered nucleii of favorable habitat during periodic lows; and (2) to disperse from these into less suitable habitats as populations increase"(Keith 1963:99).

The relationship of lynx to snowshoe hare population cycles has long been recognized and has often been used to illustrate the cyclic population phenomenon (e.g., Kormondy 1969). Keith (1963) has compiled census data derived from Hudson's Bay Company fur returns of Canada as far back as 1820, and from kill records in the United States and Canada which indicate a fairly definite ten-year cycle for several fur bearers and game animals. These include grouse, Varying Hare, lynx, fox, coyote, fisher, marten, mink, and muskrat (ibid.:61-62). Of particular interest, with respect to potential human predation upon animals, is that these population peaks are apparently progressive (ibid.:97). That is, species populations do not peak or crash simultaneously.

Whether or not larger mammals, such as the ungulates (moose, deer, elk, bison, etc.) are subject to similar "cyclic" oscillations, is a problem which will probably never be solved owing to lack of data and the present severely restricted range of these animals. However, if similar variations in population density existed in the past, they must have had as profound an effect on human populations exploiting them as cycling of hare populations have upon the lynx. Attempts to estimate the potential sustained yield or harvest of the larger animals must take into account cyclic density variation. The same can be said for the subsistence strategy of human predators whose livelihood depends (at least in part) on the availability of game animals.

The Concept of Sustained Yield

Recent interest in the game ranching potential of the western Canadian Boreal Aspen forest region (Telfer and Scotter 1975), has resulted in a discussion of range requirements of several ungulate species including bison (*Bison bison*), moose (*Alces alces*), elk (*Cervus canadensis*), and deer (*Odocoileus sp.*). The area under consideration includes the aspen dominated mixed-wood forest, Parkland, lower foothills, and montane areas as defined by Rowe (1972).

A 50 square mile section of Elk Island National Park was used as a control area because of its long-term data record concerning actual animal densities. The park, located in the Beaver Hills moraine east of Edmonton, Alberta, is considered a typical section of the Boreal Aspen forest which forms an outlier within the northern Aspen Parklands (Telfer and Scotter 1975:174). Ungulate densities within the entire park have ranged from 14 bison, 13 elk, and 7 moose per square mile in 1959, to 4.3 bison, 10 elk, and 4.6 moose per square mile in 1972 (ibid.). In that 13 year period, moose populations have approached 12 per square mile in the northern portion (50 sq. mile) and may have reached 20 per square mile in the south (25 sq. mile).

Allowing for a 50% annual surplus of grasses and sedge, an estimate of 1,805,440 pounds of food from four habitat types within the park was computed. This quantity, at 2.2 lb/cwt, will support 798 bison, 525 moose, and 540 elk at a density of 18, 12, and 12 individuals per square mile respectively giving a total ungulate standing crop of 32,616 pounds per square mile and an annual yield (20%) of 6,522 pounds of meat per square mile (Telfer and Scotter 1975:Table 2).

Gross (1969) has critically examined the management concept of optimum yield in wildlife populations. In his study, the concept of optimum yield as it pertains to the theory of fishing is applied to North American deer and elk populations. Of particular interest is the assertion that maximum population density and optimum yield are biologically incompatible. It was found, for example, that birth rates and the number of offspring produced per unit of breeding stock are maximum at densities well below carrying capacity. It is apparent that net annual production actually decreases as population density increases toward the upper asymptote (ibid.:385).

Interestingly, the optimum yield level among deer and elk, and perhaps other ungulates as well, is linked to a population density in which food demands are well below the supply. Maintenance of a wild game population at the optimum yield level very likely exists to provide a safeguard against "suicidal density levels" (cf. Odum op. cit.:197) and a subsequent population crash.

Regarding the estimates of density and sustained yield as applied to potential mixed-wood forest game ranching, the proposed 20% cull rate is a figure definitely open to question. Given the statistical range of densities for bison, elk, and moose in the Elk Island Park study area, the estimate of 18 bison, 12 moose, and 12 elk per square mile seems excessive and should perhaps be the appraised "optimal" standing crop. The 20% cull rate should be thought of as a maximum rather than a sustained yield of the standing crop. It can be considered given that range conditions, hence carrying capacity, will fluctuate in accordance with other variables. This in turn must affect wildlife densities and permissible sustained yield.

Summary-Discussion

The description of behaviour and population dynamics of selected terrestrial, aquatic and avian fauna in this section requires little elaboration. The behavioural "clocks" (Figs. 5-12) included will provide important reference for later comparison. The utility of the exercise will become apparent when, in Chapter IV, an attempt is made to relate seasonal animal behaviour to historical accounts of game-kill successes. Similarly, the discussion of population control mechanisms and the postulated ten-year wildlife population cycle will serve to provide insight into availability patterns among the animals providing for human subsistence. Cyclical population dynamics may also have application toward assessing the necessity, duration, and season of human exploitation of transition zone resources.

It seems clear that the estimates of sustained yield drawn from data on bison, elk, and moose populations in Elk Island Park are consistently high. The 20% yield factor is perhaps twice as high as it should be. A 10% cull rate would reduce the annual harvest of biomass to about 3,250 pounds per square mile. This figure compares favorably with that of a study in Montana where the standing crop of a combined population of bison (50%), mule deer, elk, and bighorn sheep was estimated at 14,000 pounds of meat (21 animals) per square mile (Kendeigh _op_. _cit_.:Table 9-5). A 20% cull rate at this level would yield 2,800 pounds of meat per square mile.

The findings of Bouckhout (1971) regarding feeding interactions among ungulates in Elk Island Park supports the criticism of Telfer and Scotter's density/yield estimates. Bouckhout (op. cit.:39) found that browse resources were below optimum (over used) in the park which suggests the ungulate population has approached or exceeded the upper limits of its range.

An important feature of winter feeding habits among elk, moose, and deer is that all three animals exhibit marked convergence with respect to the use of browse (Bouckhout 1971:39). Although browse constitutes a major portion of the moose's diet throughout the year, elk prefer summer and usually resort to browsing only when deep snow inhibits access to grasses, forbs, and sedge (ibid.). Bison, because of their ability to "crater" down through deep snow to graze, do not compete with other ungulates for winter food.

The presence of all habitat and range requirements of bison, elk, moose, and deer in the prairie-forest ecotone is enhanced, perhaps even maximized, by the mosaic vegetation pattern in that ecosystem. Although precise estimates of the ungulate standing crop for the transition zone are not available, it may have been as high as the 6,500 lbs/sq. mile given as the potential for intensive game ranching in the aspen dominated mixed-wood forest.

CHAPTER II

Part 1

INHABITANTS OF THE PRAIRIE-FOREST ECOTONE

Introduction

Determining the ethnic identity of the group or groups that used or occupied the Alberta prairie-forest ecotone presents a major obstacle. It is only by about A.D. 1790[1] that the location of various indigenous and "foreign" groups are fairly well established. Prior to that period, ethnohistorical records are either ambiguous or lacking altogether. Rapid population movements, re-alliances, warfare, and rapidly depleting food resources are all symptoms of the Cree-Assiniboine territorial expansion into the western Boreal Aspen forest.

The native groups which are of primary concern in this discussion include the Blackfoot, Assiniboine-Cree, and three Athabascan sub-groups; the Beaver, Sekani, and Sarsi. The Blackfoot have been traditionally located in the northwestern plains region where they practiced a subsistence strategy commonly referred to as the bison economy (cf. Ewers 1955). More recent research (see, for example, Quigg 1974) indicates that ecosystems other than the plains figured prominently in the annual subsistence pattern of Plains Indians and that many groups relied seasonally upon the resources present in riverine, outlier, and forest edge areas (Bonnichsen & Baldwin n.d.). The Blackfoot Indians probably controlled the largest geographic area of any of the groups discussed.

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[1] Unless otherwise stated, all dates in this chapter are A.D.

Mixed-wood Forest Athabascans

To the north, beyond the plains and parklands, is the Boreal Aspen forest region within which the Athabascan speaking Beaver and Sekani Indians are usually associated (Jenness 1963; Goddard 1916). These groups are usually characterized as being composed of small, highly mobile bands who relied heavily on a variety of hunting, trapping, and snaring techniques for their sustenance. For these groups, the importance of moose, at least historically, should be noted but is perhaps often overstressed (cf. Morice 1905). Fish as well as hare (when at or near peak cycle) are recognized to be "fail-safe" resources for most Athabascan groups (Jenness op. cit.:379; Goddard op. cit.:216). Perishable substances such as wood, bone, and antler figured prominently in the material culture of these mixed-wood forest peoples; a characteristic which has important ramifications for archaeological interpretation.

Bryan (1969) has addressed the problem of identifying the aboriginal inhabitants of the Alberta Boreal mixed-wood forest with particular reference to those groups encountered by the Cree as they expanded their trapping territory into the region near Lesser Slave Lake. Much confusion has arisen over use of the term "Slave" or "Slaves" as applied by Cree (and others) to various Native groups. For example, the term "Slave" which translated into Cree as "strange groups of Indians," was applied equally to Beaver and other Athabascan Indians as well as to the Blackfoot without apparent regard for ethnic distinctions.

Beaver Indians

Historically, it seems well established that the Beaver Indians controlled the valley of the Peace River well west of the Peace-Athabasca lowlands but that their origins were probably in the eastern Alberta forests. Goddard (1916:209) citing an informant, places the Beaver at least as far east as Lesser Slave Lake when the Cree arrived forcing them out. Using several lines of evidence (Bryan 1969:36) felt the "Slave" Indians encountered by Cree trappers were in all likelihood Beaver Indians who originated perhaps as far east as Portage La Loche in western Saskatchewan. Jenness (1963:382) suggests that by 1750 the Beaver inhabited ". . . not only the entire basin of the Peace River below its junction with the Smoky, but the district around Lake Claire and the valley of the Athabasca River as far south as the Clearwater and Methy portage". Within a decade of that date, however, the Cree had driven out or destroyed these people, pushing them westward to their historic territory in the Peace River basin (ibid.). In addition there is evidence that a "contested" zone (cf. Hickerson 1962) existed between Lesser Slave Lake and the Peace River where, after acquiring firearms about 1780, the Beaver halted the Cree intrusion.

Sekani Indians

The Sekani controlled both the Parsnip and Finlay Rivers as well as the valley of the Peace as far down as the present town of Peace River (Jenness *op. cit.*). Symington (1969:11) also locates the aboriginal Sekani in the Peace River valley with the Beaver east of them in the Peace-Athabasca lowlands. By the end of the Eighteenth Century, they had been pushed as far west as Stuart Lake, British Columbia, into traditional Carrier territory and northwestward into the Liard River region of the Northwest Territories (Jenness *op. cit.*). Conflict and warfare between Beaver and Sekani Indians (Godsell 1938:232) may be viewed as symptomatic of territorial pressures initiated by the Cree expansion.

Sarsi Indians

The Sarsi are mainly located in the area between the upper headwaters of the North Saskatchewan and Athabasca Rivers (*cf.* Mackenzie 1801:lxx; Richardson 1851:6) or in the vicinity of the Jasper Park forest (Barbeau 1960). David Thompson (1916:367) located the Sarsi ". . . four to six hundred miles in the plains, eastward of the Mountans [sic]. . .". Alexander Henry writing in 1809 (1897:532) found them *south* of the North Saskatchewan River in the vicinity of Beaver Hills adjoining Blackfoot territory. It appears that the Sarsi controlled much of the same territory throughout the Eighteenth and Nineteenth centuries but with occasional (perhaps seasonal) incursions onto the plains (Jenness 1938:3).

The linguistic affinities which the Sarsi shared with the Beaver and Sekani who inhabited more northerly regions was noted by many early writers (e.g., Mackenzie, Thompson, Henry). The cultural configuration of the Sarsi became more and more like that of the Blackfoot with whom they were eventually allied (White ed. 1913:409).

The Sarsi are most closely affiliated linguistically with the Sekani from whom they apparently separated (according to recorded legend) as a result of a blood feud within the latter or parent stock (cf. Godsell 1938:202; White ed. op. cit). The existence of this legend in Sarsi oral tradition suggests that the division must have occurred in the not too distant past. Lowie (1954:9) suggests a date of perhaps 1700 while Jenness (op. cit.) places it ". . . toward the end of the 17th century".

Unlike their Athabascan relatives, seasonal movement of the Sarsi conformed very closely to that of their principal food resource: the buffalo. The increasing tendency within the Sarsi toward a plains-like economy stems from two sources: (1) pressure on the eastern border of their territory by encroaching Assiniboine and (2) the right of access to the plains resources guaranteed by the alliance formed with the Blackfoot confederacy which controlled them. During the greater part of the year (that is winter, according to Jenness (op. cit.)) they existed in small groups or subdivisions of their bands camped at distances of one or two miles apart. These camps were normally located ". . . along the edge of the woods" (Jenness op. cit.:12). Oddly, the Sarsi are alleged to have used bison pounds and jumps primarily in summer (ibid.) whereas other Native groups in the study area practiced communal buffalo pounding activities in late winter (Arthur 1974:121).

Cree-Assiniboine Expansion

By 1800 the Eastern Cree and their Assiniboine allies had successfully driven a wedge into Alberta along an east/west axis through the Boreal Aspen forest. The Cree expansion was largely generated by economic forces and migration westward was made easy as the group already possessed well developed social and economic adjustments to the broad Boreal forest ecosystem (Fisher 1969). Recognition of any territorial boundaries dissipated with the acquisition of firearms and other European made tools. Invasion of Athabascan territories of the western forest was hastened by an ever dwindling beaver population and propelled by the quest for fresh trapping grounds.

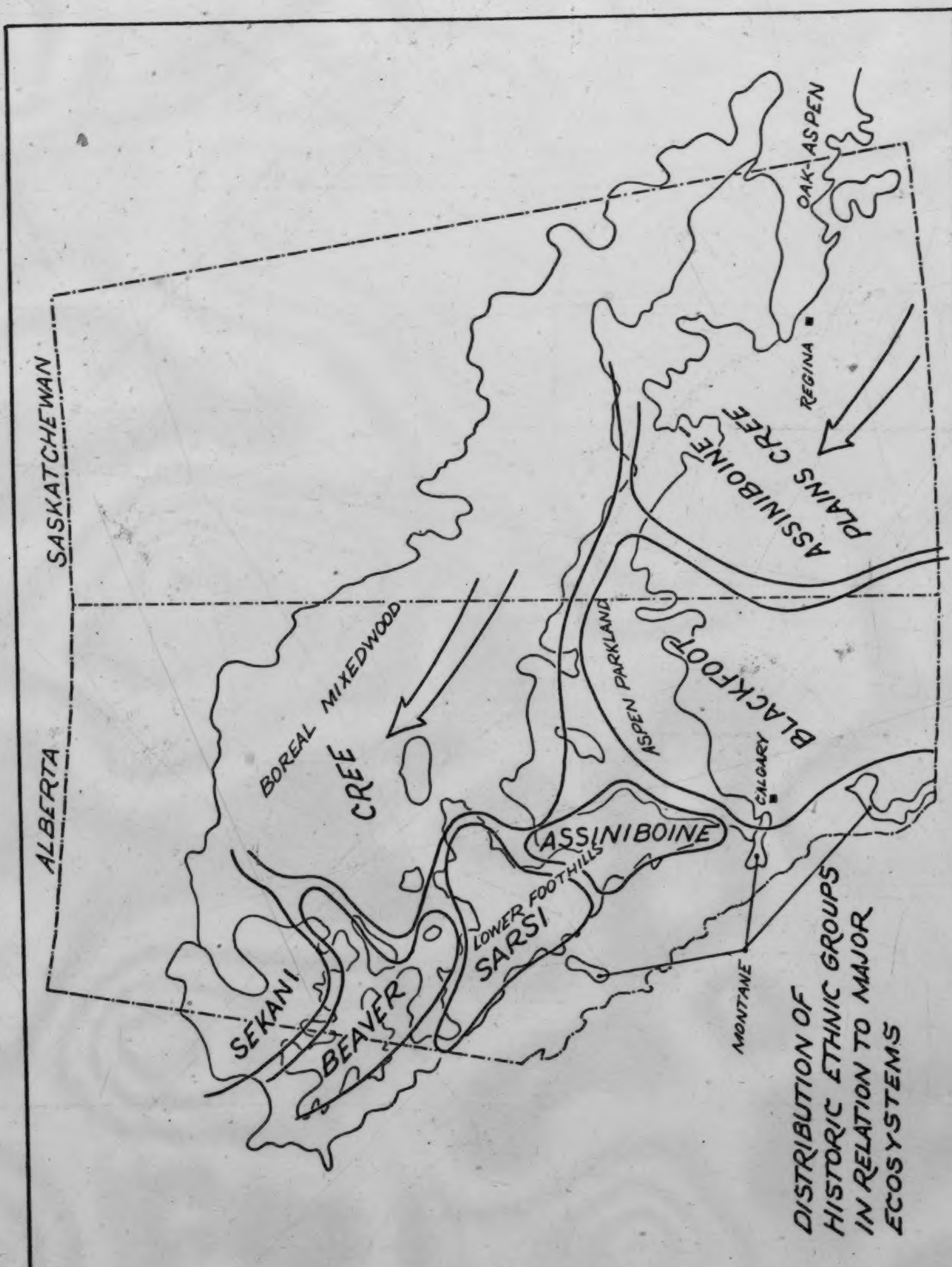
At the close of the Eighteenth Century, the Sarsi were pinned to the foothills region by advancing Assiniboine allies of the Cree. North of them were their kinsmen the Sekani, and east of the Sekani were the Beaver. To the south were the Blackfoot proper and to the east and northeast were the Cree.

The data presented thus far suggest a fairly orderly relationship between the aboriginal homelands of Athabascan subgroups and the forest subregions within the Boreal Aspen forest. The Beaver at the time of contact by the Cree were spread throughout the Boreal mixed-wood section of Rowe's (1972) Boreal Aspen region around major lakes and river systems. If we accept Bryan's (1969) hypothesis concerning the identity of the "Slave" Indians, then Beaver territory can be extended eastward at least as far as western-most Saskatchewan. The description of Sekani controlled territory along the Parsnip, Finlay, and upper Peace Rivers coincides well with the large northern area of Rowe's lower foothills subregion while the Sarsi seem to have occupied the southern portion of that same subregion. The congruence between Native groups and environmental subregions (Fig. 15) is an indication that these groups possessed adaptive strategies which were closely tied to the resources available within each subregion.

Inhabitants of the Ecotone

Identification of links between ethnic groups and the prairie-forest ecotone is not easily accomplished owing both to lack of records and large scale displacement of indigenous groups such as the Beaver Indians. There are some clues to be found among both the Blackfoot tribes and Assiniboine-Cree (including Plains Cree) newcomers as to how the resources of the transition zone were utilized which may have implications for prehistory.

Examination of early historical records (pre-1825) in the prairie-forest ecotone has revealed an interesting winter utilization pattern practiced by bison hunting groups. Observations of early


ALBERTA
SASKATCHEWAN
SEKANI
BEAVER
SARSI
LOWER FOOTHILLS
ASSINIBOINE
BOREAL MIXEDWOOD
CREE
ASPEN PARKLAND
BLACKFOOT
CALGARY
MONTANE
ASSINIBOINE
PLAINS CREE
REGINA
OAK-ASPEN

DISTRIBUTION OF HISTORIC ETHNIC GROUPS IN RELATION TO MAJOR ECOSYSTEMS

Figure 15

fur traders stationed at Hudson Bay and Northwest Company posts along the North Saskatchewan River form the bulk of the data presented in the following pages. All posts are located in the transition zone.

Winter Occupation

Seasonal availability of game animals because of behavioural adjustments to feeding, social, and reproductive activities, are equally prone to scheduled harvesting as plant resources. Often, seasonal hunting patterns of prehistoric groups or cultures are reconstructed by means of age-grading skeletal material or by independent evidence such as the association of seasonally available plant remains. Lacking (as we do) such data, a reasonable alternative is to examine historical records, in light of known behavioural characteristics of important animal resources, for possible clues to an effective hunting schedule.

Historic documents originating from several fur trading posts along the North Saskatchewan River in Alberta and Saskatchewan indicate that the prairie-forest ecotone had a very important function with regard to the subsistence strategy of buffalo hunting peoples. This strategy was directly related to the mid-to late-winter movements of bison herds into the shelter of the wooded region adjoining the northern plains region. The records considered here range from 1772 to 1820; a period of 48 years. They clearly show that the building and operation of buffalo pounds (enclosures) was a major winter food getting activity for groups participating in the plains bison economy.

Mathew Cocking (1908:109), accompanied by a band of Gros Ventres from the south, explored territory between the branches of the North and South Saskatchewan Rivers. In October 23, 1772 he stated:

> Every person repairing the Beast pound .... This pound was made by our Arthithinue [Gros Ventre] friends last spring, who had great success ....

Again in November he remarked:

> The Natives can make nothing of the pound so are obliged to kill the Buffalo with the Gun, and Bow and Arrows.
> (Ibid.:110)

Then on December 4, the first bison appear.

> The Arthithinue Natives drove into the pound 3 male & one female Buffalo, & brought several considerable droves very near.
> (Ibid.:111)

Later in January after having only middling success with the pound, Cocking prepares to move with the Gros Ventre to another site. On January 22, 1773, he writes:

> A young man joined us from the Beast pound to the Eastward of us, where he intended to go: He says that the Buffalo are so scarce that the Indians are distressed for want of food.
> (Ibid.:113)

And, on February 23:

> This morning the Indian arrived ... with information that all the Natives were pitched further on ... intending to build a Beast-pound there: My Leader with eleven tents of Asinpoet [Assiniboine] Natives unpitched intending to proceed there.
> (Ibid.:115)

On March 27, Cocking notes:

> We arrived at the Beast pound, where we met with my Leader again, with 4 tents of Neheathway [Cree] and 20 tents of Asinpoet Natives.
> (Ibid.:116)

The following day the ". . . Natives pounded several Buffalo: they bring droves to the pound, but only a few enter into it" (ibid.).

Alexander Henry (the elder) near the site of Fort Des Prairies recorded in February 1776:

> Arrived at the island, [forest outlier] the woman [Assiniboine] pitched a few tents while the chief led his hunters to its southern end where there was a pound or enclosure.
>
> The day was spent making repairs, and by the evening all was ready for the hunt. (Henry 1809:284)

Cree were noted by M'Gillivray in 11 December, 1794, impounding buffalo near Fort George (1929:49). On October 30, 1794, while at Fort George, M'Gillivray noted a report by an Assiniboine chief that:

> ... vast herds of buffaloes are at the Paint (Vermillion) River where he intends to make a pound in the course of the winter.
> (M'Gillivray 1929:38)

Later that season on 19 January, 1795 M'Gillivray (ibid.:50) recorded that ". . . the Grand River Assiniboine went off to their pound. . ." which had apparently been completed. On 9 February, 1795 M'Gillivray observed:

> ...a Grand River chief with 8 women arrived from their pound with about 500 lb Pounded [dry] Meat. (Ibid.:53)

At Edmonton House, George Sutherland wrote on 3 January, 1797 to Peter Fidler at Buckingham House:

> Many of your Indians are in this quarter and doing nothing but pounding buffalo.
> (in Johnson ed. 1967:81)

William Tomison writing at Edmonton House records that on 3 March, 1798:

> At noon the Indians [possibly Assiniboine] went away also....two more arrived from a buffalo pound....
> (in Johnson ed. 1967:111)

On April 25 in a letter to George Sutherland then at Buckingham House, Tomison wrote:

> ... all of the Southerd [Cree] Indians on the south side of the river was at two buffalo pounds until lately, thirty two tents in number....
> (in Johnson ed. 1967:118)

Later the same month he records:

> ... a band of Southerd Indians arrived...they have been lying at a buffalo pound all winter and neither have procured furs or provisions.
> (Ibid.)

One year later on 8 April, 1799, William Tomison noted that at noon:

> ...fifteen tents of Indians arrived on the other side [of the river] from a buffalo pound where they have been most part of the winter....
> (Ibid.:162)

Hudson's Bay company clerk, James Bird (Johnson 1967:235) writing from Edmonton House in 1800 entered in his journal on 21 February that:

> The men who went for meat yesterday arrived and tell us that twenty tents of Blackfeet have made a pound quite near the hunting tent and drove off every buffalo....

Archibald McLeod (in Gates 1933:151) while at Fort Alexandria writes on January 10, 1801:

> In the evening three young men came here from a pound that's five days march off....

Alexander Henry (the younger) (1897:576) similarly observed at Fort Vermillion, Alberta on December 20, 1809 that:

> The Blackfeet have repeatedly sent for my neighbor and me to come to their camp and see buffalo driven into the pound.

Again, on January 24, 1810, Henry writes:

> A band of Crees from their pound on the Horse Hills came to trade provisions....
> (Op.cit.:581)

John Franklin (1969:109) writing from Carlton House while on the first of three historic northern expeditions recorded on 6 February, 1820:

> ...we accompanied Mr. Prudens (factor at Carlton) on a visit to a Cree encampment, and to see a buffalo pound, both of them situated about six miles from the house....

The Energy Subsidy

The pattern of winter buffalo pounding in the prairie-forest ecotone by Blackfoot, Gros Ventre, Cree and Assiniboine appears strongly linked with the movement of bison into the woodlands from December through March. This seasonal cycle, as will be shown in Chapter IV, is a direct response to severe weather on the open plains country.

Late winter is a "critical" period in the annual cycle of consumer animals. Aboriginal man on the northern plains is no exception, since for a population whose energy consumption was ultimately derived from solar radiation (as opposed to fossil fuel) winter is the time when energy requirements are the highest. Thus, the energy available in the form of fuel and food can be viewed as limiting factors to the carrying capacity of the environment with respect to human populations inhabiting the bison range. Seasonal incursions into the ecotone may, perhaps, be viewed as an energy subsidy that serves to increase the human carrying capacity above that which would normally be available to a population whose movements were limited only to the summer (plains) bison range.

The Role of Assiniboine and Cree

The appearance of Assiniboine and Cree in the transition zone participating in winter bison pounding activities raises a question regarding the use of the ecotone by former Athabascan inhabitants of the mixed-wood forest. For example, is the relatively recent Assiniboine-Cree hunting pressure on the winter bison economy filling a void in the transition zone due to their proximity through trade, or are these recent arrivals filling a niche which was formerly occupied by forest Athabascans?

Certainly, there is no counterpart to bison pounding in the traditional Cree subsistence economy. Mandelbaum (1940:189) suggests that the Plains Cree ". . . were perhaps the most proficient of the Northern Plains people in the use of the pound." The same may be true of the Assiniboine since as observed by Alexander Henry (1897:518):

> ...these people are the most expert and dextrous nation of the Plains in constructing pounds, and in driving buffalo into them.

It seems unlikely that the Assiniboine Cree pressure on winter bison herds represents a recent addition to that shown for traditional plains groups owing to the displacement of previous potential occupants. As late as 1865 John McDougall (1971:180) indicated that large scale bison pounding was still a viable economic activity for Cree in the transition zone.

Summer Occupation and the Information Bias

The subsistence activities of various groups documented above represent only four or five months at best of a twelve month annual cycle. Except for occasional trips to trading centers along the North Saskatchewan River, the transition zone would appear to be essentially vacant throughout spring, summer, and fall. It should be noted, however, that historic records are considerably biased by the fact that journal records are extremely scanty with regards to local Native activities generally from May through September. During that time, trading clerks and factors ordinarily made their annual trips to and from Hudson's Bay or Montreal to deliver the year's furs and to re-supply with trading stock.

In view of this information bias, which may not in fact have any real bearing on the problem even if corrected, it may be instructive to examine some ethnographic models for aboriginal subsistence cycles observed elsewhere but in a similar (ecotonal) context. In actuality, there are several ways in which an ecotonal border might function with regard to Native subsistence/settlement patterns. Both ethnohistory and archaeology present clues to the possible alternatives. These are reviewed in Chapter III.

CHAPTER II

Part 2

HISTORIC RECONSTRUCTION OF SEASONAL SUBSISTENCE AND RESOURCE AVAILABILITY PATTERNS

Introduction

Delimiting the seasonal scheduling of subsistence activities among aboriginal populations has been a traditional concern of archaeologists and ethnographers alike (cf. Lee 1968; Helm and Lurie 1961; Nelson 1973; Thomas 1973). The seasonal round employed by a hunting-gathering population is a means whereby energy expenditure is maximized by the harvesting or procurement of food resources when they are available in greatest quantity. Implicit in this type of subsistence strategy is a kind of adjustment which avoids over-exploitation of resources which are annually renewed. Obviously, a procurement pattern that over-harvests any one of the seasonally available resources would be a short term one indeed.

The Edmonton House Record

A survey of published journals for trading posts in the western prairie-forest transition was made and notation taken for every mention of fish and game resource entered in the journals. Thus a record was compiled on a daily/monthly/yearly basis (Table 2)

Table 2

Numbers of Game Animals Taken at Fort Edmonton: 1795 - 1800

	Bison	Elk	Moose	Sturgeon	Waterfowl	Other
1795						
July	--	--	1	3	--	--
Aug	--	--	2	53	--	--
Sept	7*	--	1	--	--	--
Oct	2*	--	--	--	--	--
Nov	8	4	--	--	--	--
Dec	10	4	--	--	--	--
1796						
Jan	16	--	1	--	--	--
Feb	23	--	--	--	--	--
Mar	3	--	--	--	--	--
Apr†	--	--	--	--	--	--
May	6*	--	--	--	--	2 swans
June†	--	--	--	--	--	--
July	--	--	--	--	--	--
Aug†	--	--	--	--	--	--
Sept†	--	--	--	--	--	--
Oct	4	--	1	--	--	--
Nov	7	4	--	--	--	--
Dec	32	--	--	--	--	--
1797						
Jan	59	--	--	--	--	--
Feb	49	--	--	--	--	--
Mar†	--	--	--	--	--	--
Apr†	--	--	--	--	--	--
May†	--	--	--	--	--	--
June†	--	--	--	--	--	--
July†	--	--	--	--	--	--
Aug†	--	--	--	--	--	--
Sept†	--	--	--	--	--	--
Oct	3	--	6	--	--	--
Nov	--	4	4	--	--	--
Dec	15	5	--	--	--	--
1798						
Jan	24	--	--	--	--	--
Feb	54	--	--	--	--	--
Mar	34	--	--	--	--	--

..... continued

Table 2 -- continued

	Bison	Elk	Moose	Sturgeon	Waterfowl	Other
1798						
Apr†	--	--	--	--	--	--
May	2*	2*	--	--	--	--
June†	--	--	--	--	--	--
July†	--	--	--	--	--	--
Aug	4*	--	--	--	--	--
Sept	1	5	2	--	--	--
Oct	1	5	2	--	--	--
Nov	--	8	2	--	--	--
Dec	8	2	--	--	--	--
1799						
Jan	21	--	--	--	--	--
Feb	18	--	--	--	--	--
Mar	6	--	--	--	--	--
Apr	--	--	--	--	7	4 beaver
May	1	--	1	--	4	2 beaver
June†	--	--	--	--	--	--
July†	--	--	--	--	--	--
Aug	1*	--	--	--	--	--
Sept†	--	--	--	--	--	--
Oct	--	2*	--	--	--	--
Nov	2	--	2	--	--	--
Dec	4	3	1	--	--	--
1800						
Jan	3	--	--	--	--	--
Feb	8	--	--	--	--	--
Mar	19	--	--	--	--	--
Apr†	--	--	--	--	--	--
May	3*	--	--	--	--	--
June†	--	--	--	--	--	--
TOTALS						
1795-96	75	8	6	100	2	--
1796-97	151	4	2	--	--	--
1797-98	132	11	10	--	--	--
1798-99	60	20	7	--	11	6 beaver
1799-1800	40	5	3	--	--	--

*Figures indicate that these animals were taken beyond the vicinity of Fort Edmonton (e.g. enroute to Buckingham House).

†No data for the month indicated.

for all subsistence animals procured. It was hoped that this would (1) yield an inventory of all important faunal resources comprising the prairie-forest transition subsistence base, and (2) provide an index to the annual distribution of game hunting successes which could allow construction of a tentative model of seasonal hunting or game availability patterns.

Initially, the records appeared too fragmentary and often incomplete or biased by either lack of detail or total omission. However, a substantial five-year inventory is available from the journals of three Hudson's Bay factors writing from Edmonton House in the years 1795 to 1800 (Johnson ed. 1967). It is derived from the journals of William Tomison, James Bird, and George Sutherland. The value of the record stems from the fact that at this early date the prairie-forest transition zone was largely undisturbed with respect to the distribution of its natural fur and game resources (cf. Ray 1971:122 passim).

Summary of Fish and Game Kills

To summarize, the bulk of the game resource data (in order of importance) is comprised of bison, "red deer" (Wapiti), moose, and sturgeon. Occasional mention of lesser animals includes beaver and waterfowl (an occasional swan). The distribution of these resources through time is remarkably consistent (Fig. 16).

Recognizing the lack of data from May, June and July (the period when traders were normally absent from the posts), the distribution of game procurement successes was as follows. After

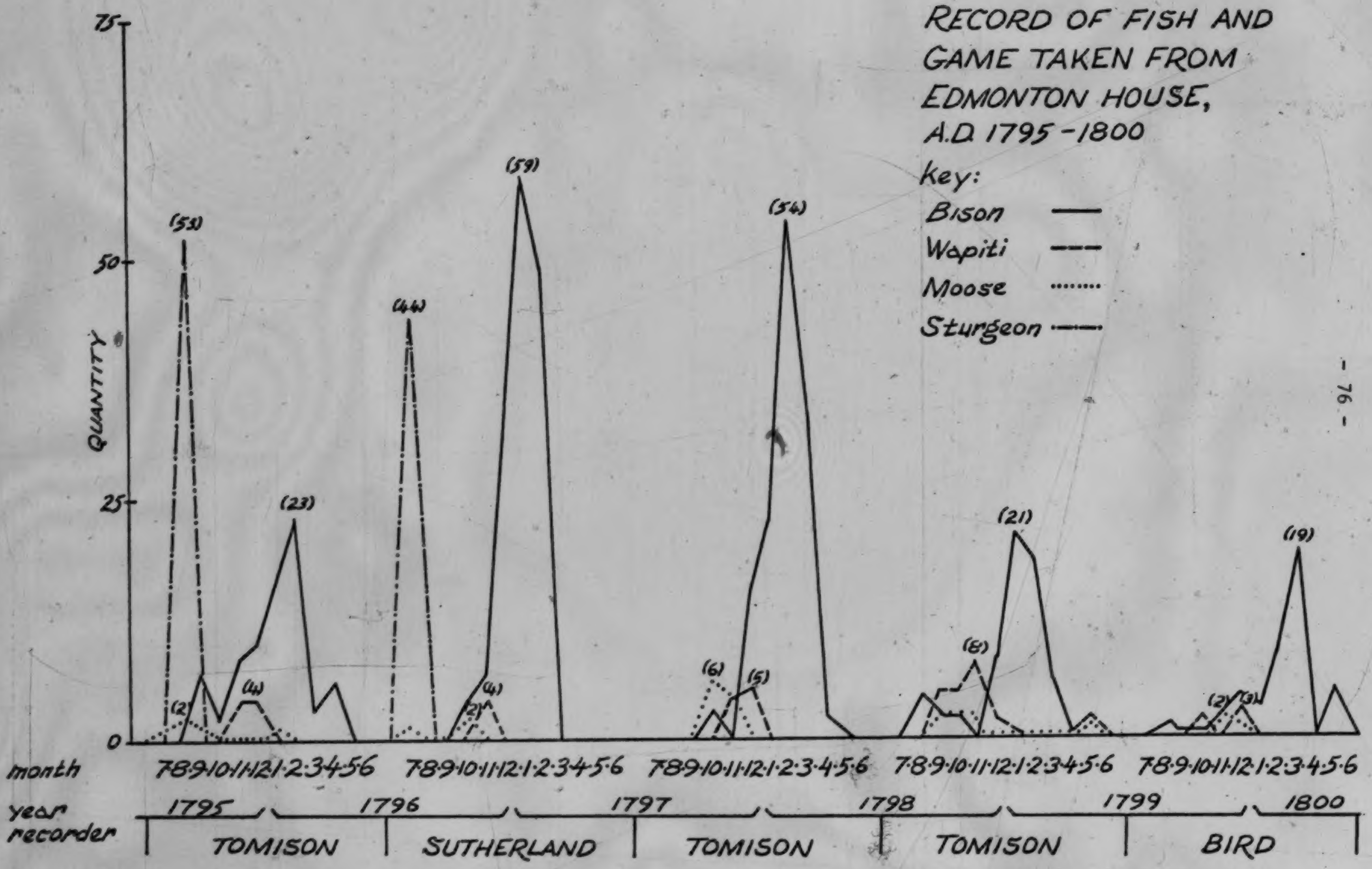

RECORD OF FISH AND
GAME TAKEN FROM
EDMONTON HOUSE,
A.D. 1795 - 1800
key:
Bison
Wapiti
Moose
Sturgeon
QUANTITY
75
50
25
0
(53)
(2)
(4)
(23)
(44)
(2)
(4)
(59)
(6)
(5)
(54)
(8)
(21)
(2)
(3)
(19)
month
7·8·9·10·11·12·1·2·3·4·5·6
7·8·9·10·11·12·1·2·3·4·5·6
7·8·9·10·11·12·1·2·3·4·5·6
7·8·9·10·11·12·1·2·3·4·5·6
7·8·9·10·11·12·1·2·3·4·5·6
year
1795
1796
1797
1798
1799
1800
recorder
TOMISON
SUTHERLAND
TOMISON
TOMISON
BIRD

Figure 16

return of the yearly outfit from Hudson's Bay, sturgeon appeared first as the major food resource. These were taken with nets in the North Saskatchewan River in July and August but tapered off rapidly thereafter. Moose were taken in small numbers from September through November with the greatest kill occurring in the month of October. "Red deer" or Wapiti first appeared in October for four of the five years, although the optimum kill occurred in November and December.

The bison began to appear sporadically from August through October, but originated largely from hunting forays beyond the wooded area. By December, however, this animal was taken in increasingly large numbers, reaching a peak in January, February, or March depending upon the severity of weather on the open grasslands. With the disappearance of buffalo from the transition zone by March or April, sporadic hunting of beaver and various waterfowl completed the winter cycle. Thereafter hunting was essentially curtailed while preparations for the spring outfit were made.

This graphic display of bison hunting successes as recorded at Edmonton House, enjoys substantial support from the observations of others as previously cited; particularly with respect to the seasonal migrations of buffalo in and out of the transition zone. Similarly, fragmentary records from Fort Alexandria and Fort Vermillion compare favorably with the pattern illustrated here.

The Relationship of Kill Rate to Animal Behaviour

The harvest of moose coincides perfectly with the fall rut when bulls are typically less wary and can be summoned by mimicking the mating call of the cow. Wapiti, even though they enter the rut four to six weeks earlier than moose, appear in greatest numbers one month after the moose harvest. This is difficult to explain unless the Wapiti kill is geared to take advantage of the larger aggregates; particularly of hinds, calves, and yearlings which form groups after rut and move onto their winter range. The bulls behave similarly but details regarding six of the animals killed is not sufficient to determine whether hunting was selective with respect to these groups.

The availability of waterfowl simply coincides with the spring migration of ducks, geese, and swans into the wetlands nesting ground. Their numbers would, of course, continue to increase through April and May until the spring migration was complete and all nesting areas filled. The period of actual nesting and of flightlessness occurs too late in the season to have been recorded but this is a potential which will be discussed later.

Sturgeon are noted in the Edmonton House subsistence base only during the first two years of the five-year record. This is difficult to explain since these fish apparently comprised a staple food item for the fur traders (Table 2). It seems likely that sturgeon were still being netted but was perhaps becoming scarce after the fall of 1796.

It should be noted that although fish are available throughout the year, there is good reason to consider fall an optimum season for netting in a riverine environment. Unlike the lakes, larger rivers accumulate runoff from a vast area during the spring freshet which raises the mean water level resulting in the transport of considerable debris. Setting costly nets in springtime or early summer would be an expensive enterprise due to the heavy flotsam. Late July to early August, by virtue of reduced water level and velocity, is perhaps the earliest that nets could be profitably set for river fishing.

Validity of the Record

A few comments are in order regarding the objectivity and accuracy of the Edmonton House subsistence record. The validity of the apparent game availability pattern seems assured by the fact that three separate observers (that is, Tomison, Sutherland, and Bird) recorded essentially the same phenomena throughout the five-year period. Fragmentary records from Fort Vermillion and Fort Alexandria lend further support to its validity.

With regard to accuracy, it can be shown that the total quantity of game resources is probably sufficient to support the suggested number of men wintering over at the fort. The estimated average intake of fresh meat is based on the mean weight of recorded bison, Wapiti, and moose after the manufacture of pemmican. Tomison, for example, indicates that 5,310 pounds of pemmican was made to feed 46-48 (Av. 47) men during the 37-day journey (May 24-

June 30) to York Factory in 1798 (Johnson ed. 1967:115 passim). One year later, he indicates that 5,750 pounds of pemmican was made to feed 36-42 (Av. 39) men over 70 days (May 20-July 20) (ibid.:161-63). Since bison were normally used in making pemmican, which is about 50 percent fat, 25.3 and 27.4 animals would be required in 1798 and 1799 respectively for this purpose.

The total bison kill for 1798 was 132 animals. Twenty-five were used for pemmican leaving 107 bison plus 10 moose and nine Wapiti (Table 2). The bison kill in 1799 was 60 animals minus the 27 used for pemmican leaving 33 bison, seven moose, and 20 Wapiti (Table 2). Using an average live weight of 1,050 lb., 884 lb., and 598 lb. for bison, moose and Wapiti respectively, and assuming a 50 percent rate of useable biomass, a total of 63,286 pounds (1798) and 26,399 pounds (1799) of fresh meat was available for consumption from August through May (305 days). This quantity is equivalent to 4.4 lb./man/day (1798) and 2.2 lb./man/day (1799). This can be considered a minimum owing to the missing portion of the annual record.

It is suggested that given the conservative 50 percent useable meat rate, these figures and hence the recorded kill rate, are probably very nearly correct for the periods stated. Although the 2.2 lb./man/day rate for 1799 may appear minimal, it should be pointed out that while the protein content of wild meat is comparable or even greater than that of domestic beef, the fat content of the former may be less than 10 percent of the latter (Telfer and Scotter 1975:179). Furthermore, there is no control over the number of animals that were taken and consumed by the operators of the hunting camps. Nor is there any record of smaller game kills such as grouse and hare which during a peak cycle could contribute considerable biomass to the subsistence base.

Population Cycles and Sustained Yield

In addition to the progressive and cyclical annual pattern exhibited by game kill records at Edmonton House, it is interesting to note the apparent peak in bison abundance in January of 1797. It shows a rather orderly decrease from 59 animals to 54, 21 and 19 animals over the four years following (1797-1800).

It would be extremely valuable to be able to assess the Edmonton House record with respect to the concept of sustained yield. At the present time, however, it is impossible to control the potential range of hunting camps from the post due to lack of information in the journal records. Otherwise it might be possible to project previously cited density figures for wild ungulates, compute the 20 percent yield factor, and compare that figure with the apparent five year recorded yield. Without these data, it cannot be demonstrated, for example, whether the decline in bison abundance following 1797 is the result of over-kill, a natural population cycle, or a shift in range.

Comparisons with Other Data

The cyclical game kill record obtained from Edmonton House compares favorably with similar seasonal data compiled by Ray (1971:82) for the Prairie Assiniboine inhabiting the parkland belt in Saskatchewan and Manitoba during the late Seventeenth Century and early Eighteenth Century.

> These bands commonly resorted to the parklands in the winter season to seek shelter, hunt bison, and trap wolves. In spring...they often set up fish weirs...to take sturgeon.
>
> ...these Indians spent the summer in the open grasslands hunting bison on foot.
>
> Towards the end of the summer months and into the autumn, even early winter in some instances, a trading trip was made to the Mandan Villages to obtain stocks of Indian corn.

The obvious discrepancy here is the fact that rather than hunting moose and Wapiti in fall and early winter, the Assiniboine substituted agricultural products from the south.

In contrast the western Cree were engaged in an annual subsistence cycle which very closely approximated the Cree and Ojibwa of the east (interior) with one exception. The Cree-Ojibwa cycle was as follows:

> In the autumn small groups gathered near favorable fishing sites where camps were established. Once the latter was set up the Indians began to fish and hunt large game (presumably moose and caribou).
>
> Late in...October the bands shifted locations (seeking) sheltered sites for their winter base camps.
> (Ibid.:256)

Hunting and trapping continued through the winter months and depending upon their luck, the bands might move once or twice to new locations. Early in the spring the bands returned to the site of their fall camps where canoes were stored. After completing their journey to the trading posts, the bands returned to spend the balance of the summer fishing on interior lakes and rivers (ibid.).

The Seasonal-Round of Assiniboine and Cree

The seasonal cycle of wood Assiniboine and western Cree differed in that the late winter months were spent in the parkland hunting and/or pounding bison alongside the prairie Assiniboine who possessed a well developed technology for this activity. To tap the transition zone resource base, both the Cree and Assiniboine travelled considerable distances which suggests that the seasonal availability of bison as well as moose was a known and attractive feature (ibid.:257). The overlapping subsistence schedule of the prairie Assiniboine and western Cree for the purpose of procuring wintering bison herds was apparently a stable arrangement with respect to the quantity of animals that was harvested annually. This pattern persisted for at least 75 years (ibid.:81-84 and Diagram IV).

The Changing Subsistence Pattern

Penetration by the fur traders westward from Saskatchewan and northwest into the Boreal forest region brought about several changes which are of interest to this study. The establishment of fur trade posts first in the Athabasca district and later into the Upper Mackenzie River drainage encountered new logistical problems with respect to provisioning post operators. At the same time these new trading posts brought goods to Native groups which heretofore were obliged to trade with the various companies through Cree-Assiniboine middlemen (ibid.:151-54).

The problem of provisioning trading posts in the hinterland where annual productivity was lower and the requisite technology was lacking to exploit its resources, was solved by creating posts in the transition zone which functioned primarily as food supply depots. Furthermore, the Assiniboine and Cree, having been bypassed as middlemen in the trade system, were forced by sheer economic pressure to operate as provisioners for the trading establishment. This pressure was due in large part to a gradual loss of trapping skill through over-specialization as middlemen (ibid.:161 passim).

As a consequent, not only the Cree and Assiniboine, but other groups such as the Blackfoot, Blood, Piegan, Gros Ventre and even occasionally Ojibwa and Ottawa Indians (cf. Johnson ed. 1967:4,30) began to participate as provision suppliers for the northward expanding trade network. It has been shown that the subsistence base of the transition zone was, by virtue of sheer biomass, predominated by bison. This agrees with data given by Ray (op. cit.:158-59) for provision depots elsewhere in the transition that the traders relied heavily on bison.

The Effects on Wild Ungulate Populations

The major shift in economic emphasis by all groups inhabiting or utilizing the prairie-forest ecotone had profound effects on its indigenous and seasonal wildlife populations. By 1850, according to Ray (op. cit.:252-52), winter bison procurement in the Saskatchewan and Manitoba transition was dwindling.

A similar pattern is apparent for the western prairie-forest zone as well; but occurred slightly later or about the late 1870's. Hide hunting was retarded in the Canadian west due to a lack of bulk transportation systems.

Commenting on the numbers of bison present in Canada, Steele (1915:72, 84-5, 87) states that herds were sighted not far from Fort Victoria in the autumn of 1874 and that Fort Edmonton was well supplied with buffalo during winter of the same year. In 1875, John McDougall writes that Indians living between Forts Edmonton and Victoria were ". . . still living chiefly on buffalo" (in Roe 1934:12). Such observations were repeated over much of the Canadian prairies during this general time period.

In 1878, an attempt by the U.S. Government to starve Sitting Bull and his followers into surrender resulted in the establishment of a cordon of Metis, Indian, and federal soldiers along the U.S.-Canada border with instructions to turn back any herds which were seen moving toward the Bow River grazing grounds in Alberta (MacInnes 1930:146). It was during this time that the remainder of the Canadian herd was exterminated, largely on U.S. soil. Where hills had been covered with bison in 1877, the Blackfoot were starving in 1879. For all intents and purposes the wild bison as they were formerly known were gone from the Canadian prairies.

Summary-Discussion

The concept of a seasonal round as a means of apportioning energy expenditure among aboriginal populations is a central concern of anthropological studies. In archaeology, the reconstruction of seasonal subsistence activities relies on specialized data which, for the western transition zone is fragmentary at best. As an alternative, a model for subsistence scheduling based on examination of historic records can be constructed.

A continuous five-year record of important subsistence resources procured at Edmonton House from 1795 to 1800 indicates an orderly and predictable pattern of game hunting activities. Since no records are available during the absence of post factors May through July, the subsistence cycle begins in August.

Sturgeon were the principal resource during August and September; followed by moose which are apparently taken during the fall rut, principally in October. Kill records for Wapiti peak about one month later and do not coincide with rutting behaviour. Rather, their increased numbers are due to early winter congregations of hind, calves, and yearlings which was probably the chief attraction to their procurement. Bison begin to appear in substantial numbers with the onset of severe late winter weather, reaching a peak in January, February, or March, but retreating onto the grasslands by April.

That the Edmonton House record is both objective and representative of the actual kill rate is demonstrated by the similarity of observations made by three separate recorders and comparisons with Ray's (1971) reconstruction of Assiniboine-Cree seasonal patterns. It is suggested that the pattern of overlapping utilization of the transition ecosystem by these groups which prevailed for three quarters of a century was a stable arrangement with respect to a sustained yield.

Expansion of the fur trade network into northern regions not so well endowed with large ungulate populations led to the establishment of provision centers in the western prairie-forest transition zone. A shift in the role of Assiniboine and Cree from middlemen to provisioners was a logical outcome of fur trade expansion. The intensification of bison hunting in the transition zone coupled with the exhaustion of forest game resources led to an extractive rate of wild ungulates that was beyond the acceptable yield.

The only substantial difference between the chain of events in regards to the near extinction of buffalo between the central as opposed to the western transition zone was one of time. By the late 1870's several developments in the west hastened the depletion of transition zone resources. Among the most important of these was the operation by the United States Army to cordon off the international boundary to prevent bison herds from returning to Alberta in hopes of starving the Sioux Indians under Sitting Bull. As a result, the bulk of the great northern herd was exterminated in Montana during the summers of 1878-79.

The contention that game availability is a patterned and predictable outcome of species behaviour seems evident. Procurement of big game resources is not a sporadic occurrence but rather is just as susceptible to scheduled seasonal harvesting as plant resources. Aboriginal knowledge of behavioural characteristics which rendered animals more vulnerable or locally more abundant may be viewed as an energy conserving adaptation to obtaining animal protein. Scheduled collecting of resources results in a maximized energy balance which is certainly a critical feature of efficient human adaptation. What remains to be done is to align this apparent subsistence model with the available archaeological data for comparison. This is the subject of the next section.

CHAPTER III

MODELS FOR HUMAN EXPLOITATION OF ECOTONAL BORDERS

Introduction

The models may be presented in the form of a series of postulates which, with further development and a rigorous set of criteria, could become testable hypotheses for archaeological investigation of ecotonal borders. For the present these postulates may be stated in the following manner.

(1) The Frontier Zone

The ecotone could be regarded by prehistoric inhabitants as a frontier which is simply avoided as a means of minimizing social conflict and aggression between groups on either side. In this case the ecotone would be uninhabited.

(2) The Buffer or "Debatable" Zone

The ecotone could function as a buffer zone for groups exploiting the adjacent ecosystem thereby being exploited only in times of stress, i.e., food shortage. Incursions into the buffer would only be undertaken during times of hardship and then at great personal risk. The buffer would therefore function primarily as a war-zone and game reserve.

(3) Alternate-Seasonal Exploitation

The ecotone could, because of the overlapping character of natural resources, come to be shared on an alternating seasonal basis by groups normally inhabiting the adjacent ecosystems.

(4) Exclusive Ecotonal Adaptation

The ecotone could, because of its species diversity and relatively high carrying capacity, be utilized by a single group exclusively adapted to the transition zone. This population might eventually become a distinct ethnic entity.

(5) Diffuse Cultural/Ecological Transition

The ecotone could encourage the development of a gradual cultural transition coincident with the ecological one. Emphasis on both ethnic identity and subsistence/settlement pattern would therefore co-vary with the density of plant community types contained in the transition zone.

The Frontier Zone

This pattern is best exemplified by the first in a series of papers dealing with "Edge Area Archaeology" (Fitting 1966). It is an attempt to explain the apparent dearth of archaeological resources in the State of Michigan along the Carolinian-Canadian Biotic Province transition zone. Following Odum's characterization of ecotonal borders and the importance assigned to them by other workers (e.g., Hickerson 1962), the Edge Area Project was initiated to test the proposition that

> ...if the edge effect described by Odum held true for the transition zone between the Carolinian-Canadian Biotic Province in central Michigan we would predict a greater population density. (Fitting 1966:144)

Long before this, however, the fact that distinctly different prehistoric cultural adaptations were manifest in the northern and southern portions of the state was apparent. This cultural dichotomy extends well back into the Archaic Period (ca. 5-6,000 B.C.). Fitting suggests the possibility of cultural conflict along the ecotone which he terms a "cultural tension zone" coincident with the ecological tension zone described by Odum. The results of archaeological surveys and excavation of sites in various portions of the ecotone indicate that rather than the predicted high population density that

> Where the ecological transition is abrupt, so is the cultural transition.... Where the ecological transition is gradual, there tends to be a more gradual fading of evidence of occupation. (Ibid.:147)

It is also suggested that this seeming inconsistency stems from failure to consider potential carrying capacity of ecosystems flanking the edge (ibid.). Fitting concludes that Odum's postulated edge effect did not result in higher density of human occupation because the Michigan ecotonal border is a transition from an area of relatively high carrying capacity to one of low carrying capacity. Where these two zones meet, Fitting asserts, ". . . we have an area of intermediate carrying capacity instead of the highly productive ecotone. . . ." (ibid.).

The conclusion reached in Fitting's study is tentative for two reasons. First, the inventories of prehistoric site density rely entirely on the effectiveness of archaeological survey techniques which are often dependent on surface exposures, agricultural activity, and modern population density. Also, site density may or may not reflect population density. Secondly, the moderating effects on climate produced by the Great Lakes system has resulted in a much more complex ecological picture than was at first suspected.

The Buffer or "Debatable" Zone

Hickerson (1962) provides us with an appropriate example of a buffer zone situation in his ethnohistorical study of the Southwestern Chippewa. It is especially applicable to our concern with the aspen parkland in that the setting is in a similar deciduous forest transition between the coniferous forest and the long grass prairie region of southern Wisconsin and central Minnesota. This ecotone is approximately 40 miles wide.

Historically, the Chippewa expanded from their traditional homeland in the vicinity of Sault Ste. Marie in the upper Great Lakes, migrating along the southern shore of Lake Superior. In the late 1600's they established two principal villages on the Chequamegan and Keweenaw peninsulas. The westward migration was a necessary response to the fur trade and the quest for furs. The expansion was only possible due to the peaceful relations which prevailed between the Chippewa and eastern Sioux. The latter, desiring to trade for French merchandise, eventually became partners in a full-scale commercial alliance with the Chippewa trading middlemen (Hickerson 1962:65-66).

Hickerson suggests that following the period of initial expansion into Wisconsin and Minnesota, beaver and other animal species on which the Chippewa relied for both furs and sustenance became scarce or were depleted (ibid.:14 passim). Chippewa hunting excursions consequently carried them into the broad-leaf forest belt in search of these commodities. For a time, and due primarily to the trade alliance with the Sioux, both groups hunted and trapped in the forest edge without apparent conflict or serious depletion of subsistence resources.

An end to these peaceful relations came with the establishment of a large French trading post and mission at Lake Pepin on the upper Mississippi River well within Sioux territory. Thus the basis for Chippewa/Sioux relations immediately dissolved and the justification for Chippewa utilization of Sioux hunting territory vanished (ibid.:69). Chippewa occupancy had become so intense that the former were transformed from previously desirable trading partners to unwanted competitors.

Consequently, the former cooperative hunting territory of the transition suddenly emerged as ". . . the seat of competition and the theater of war between contiguous Chippewa and Dakota (Sioux)" (ibid.:17). After successfully wrestling away the interior forest region from the Sioux, the Chippewa struggled continuously to take control of the forest transition zone. The Sioux, on the other hand, being virtually without horses and with the bison nearly exterminated east of the Red River, were forced to rely even more heavily on the ecotone for sustenance and furs for trade (ibid.:16). Hickerson's own words accurately portray the situation:

> Frequent truces, then, at which trade goods, presents, and dances were exchanged, created a situation in which open warfare remained endemic but the problem of the food and peltry quest not only was not solved but was aggravated by overexploitation of resources accruing from peace.
> (Ibid.)

Throughout this period the Chippewa continued to hunt in what amounts to a buffer or contested zone often occupying fortified camps to which they returned nightly (ibid.:25).

In a later paper, Hickerson (1965) focuses attention on the relationship between Virginia deer and the occurrence of warfare among the Chippewa and Sioux. Using both ethnographic and ecological data regarding the deer, he suggests that warfare between the two competing groups had the effect of preventing depletion of the deer population by eliminating intensive occupation of the best game areas (ibid.:45). Hickerson has further shown that where a lengthy truce was maintained by European intervention, the protective zone for the deer was destroyed and famine ensued (ibid.).

It is significant that the existence of the buffer zone was a long and fairly stable one extending from initial Chippewa settlement of the interior lakes region ca. 1780, up until the period of confinement on reservations in 1850. We should note, however, that the period of cooperative utilization of the ecotone was initiated and maintained in response to the European fur trading economy. It would seem that the relative wealth of subsistence resources in the ecotone could only support temporary intensive exploitation by two contiguous groups. As long as resources remained adequate, peaceful, cooperative exploitation prevailed. It seems clear, however, that once these resources were depleted below the expected carrying capacity, regulatory mechanisms were activated which had the effect of curbing exploitative practices and bringing them within the limits of the lowered carrying capacity.

Regarding the Southwest Chippewa, alternative resources had previously been seriously depleted by the recent emphasis on hunting in response to the fur trade economy. Withdrawal to an adjacent region for other food resources was not, therefore, a viable alternative. The only appropriate response, then, would seem to be warfare. We can only speculate on what conditions would have been necessary in prehistory to induce a similar situation in which two groups become engaged in territorial conflict. The central question, however, is not whether similar conditions existed in prehistory, but rather, how they might be recognized archaeologically.

Alternate-Seasonal Exploitation

Alternate-seasonal exploitation of an ecotonal border by two or more ethnic groups may be a useful model in the prarie-forest ecotone of Alberta. With the possible exception of the Chipewyan (Birket-Smith 1930) there is no appropriate ethnographic example of such a phenomenon. As regards the prairie-forest ecotone, this may simply be a result of the historical bias and the massive displacement of indigenous populations by invading Cree, Assiniboine, and others. Nevertheless, there is strong evidence for seasonal use of the parkland by plains groups during winter. This creates the potential for other groups to exploit the ecotone during any other part of the annual cycle with minimal chance of conflict.

Reference to the retreat to wooded areas by Plains Indians during the period of severe winter has been made in a previous section. Given the exigencies of the plains, this may well have been established practice even in pre-horse days. The retreat to wooded areas could also have included the higher elevations such as Cypress Hills or Beaver Hills, wooded river valleys, or the parkland transition zone. In either case the primary reason for this annual withdrawal to the woods was (1) for fuel and shelter from freezing blizzards, and (2) hunting of solitary animals such as moose and Wapiti, or wintering herds of bison.

The pattern of winter buffalo pounding in the parkland has been recorded for the Sarsi, Assiniboine, Blackfoot, and Plains Cree. Jenness (1938), for example, states that the Sarsi annual cycle conformed very closely to the movements of the buffalo dispersing into smaller aggregates in winter and moving into the forest edge. This group, however, did their buffalo pounding in summer (ibid.:17). The Plains Cree, according to Mandelbaum (1940) employed the chute or pound in autumn and early winter when the bison entered the wooded regions.

Alexander Henry (1897:576 passim) records a similar pattern for the Assiniboine while wintering at Fort Vermillion in 1809. Interestingly, the Assiniboine and Blackfoot were both pounding in the same neighborhood with no apparent conflict (ibid.).

The specific seasonal (winter) exploitation of the prairie-forest ecotone for bison may well have its roots in prehistory. Such a practice would leave this zone essentially open for the remaining portion of the year. Inhabitants of the mixed-wood forest ecosystem might then take advantage of the transition zone perhaps during spring when they might take the numerous waterfowl in their period of molt. In this particular region, however, alternate-seasonal use of the ecotone does not appear to have been practiced during recorded history. The Cree armed with weapons and other goods of European manufacture may have effectively forced curtailment of seasonal incursions into the ecotonal border by forest dwellers long before the appearance of written records.

Lending some support to the postulated depopulation of the forest edge environment by any group other than plains dwellers is the manner in which the Cree made their transition from woods to plains environment. Mandelbaum (1940:179) suggests that while the Plains Cree were well out on the plains by 1730, they were still quite familiar with the lakes and woodlands and shuttled in and out of the prairies seasonally. Furthermore, citing

Umfreville, Mandelbaum indicates that as late as 1790 the Cree could still be characterized by an "ambivalence between two environments" (ibid.:180). Elsewhere Alexander Henry (1897:580) complains that one of his primary concerns was keeping the woods Cree out of the prairies and in the forest because buffalo pounding was too great a temptation. This is the only indication of possible cooperation of both plains and woods dwellers in the parkland. Unfortunately, both groups were Cree and were not indigenous. Excursions into the woodlands by the Plains Cree for reasons other than pounding did not cease until the early 1800's (Mandelbaum 1940:183).

Exclusive Ecotonal Adaptation

One example of this type of ecotonal utilization is found in Struever's (1968:285) attempt to explain the apparent shift from Early to Middle Woodland subsistence-settlement patterns in the lower Illinois River valley by a population identified as Hopewell. Struever argues that the subsistence-settlement shift is coincident with the intensification of specific cultural adjustments to local resources in certain favored areas. One such favored area is the lower Illinois valley; favored at least insofar as is indicated by the occurrence of Middle Woodland Hopewell habitation sites. Struever terms the new subsistence base "intensive harvest collecting" defining it as:

> ...an adaptation centering on exploitation of selected high-yielding natural food resources characteristic of certain biomes which have sharply restricted geographic distribution within the woodlands of the northeastern United States.
> (Ibid.:305)

He goes on to say that there are two factors which are essential to the biomes in which intensive harvest collecting is feasible. These are (1) natural food products must occur in large concentrated populations and lend themselves to harvesting and, (2) the plant and animal populations from which these products are derived must be regularly renewed (ibid.), and harvesting practices must be in balance with the natural yearly production to ensure that carrying capacity is not exceeded.

At least five major resources are recognized in the Middle Woodland subsistence base of the lower Illinois valley. These are (1) nuts and acorns, (2) seeds of commensal plants, (3) white tail deer, (4) migratory waterfowl, and (5) certain species of fish. The location of the desired habitat for each of these species indicates that each has its highest productive level either within or very near the river valley itself. These habitats range from terrestrial bottomlands, hillside talus slopes, and upland forests, to aquatic communities such as small lakes, tributary streams, and the Illinois River proper. All of the above habitats are found within a range of four to five miles (ibid.).

It is interesting to note that the section of the Illinois valley considered here forms a significant portion of the forest/grassland ecotonal border of that region. Other tributary streams which dissect the prairies also form small-scale forest edge situations (ibid.:310). Like the aspen parkland, there is a maximization of edge effect within the Illinois valley itself. This is reflected in part by the occurrence of white tail deer which is considered an edge species. In addition it should be noted that besides the oak-hickory prairie-forest ecotone recognized by Struever, there is a second transition zone located between the riverine and terrestrial ecosystems in the valley bottom. This particular zone is utilized extensively by nesting migratory waterfowl just as are the numerous aquatic communities of the aspen parkland. Struever concludes by noting that:

> It is interesting that culture change during the Middle Woodland period in the western Great Lakes appears most marked in localities where this convergence of high-yielding populations of several plant and animal species seems to have existed.
> (Ibid.:311)

This is not only interesting, but largely predictable, given the apparent intensive adaptation to the ecotonal environment. It may be noted, however, that just because a high-energy yielding habitat exists, does not ensure that it will be exploited to its maximum carrying capacity by any group at any time. As Struever has suggested, the eventual explanation of the Hopewell phenomenon may lie in a response to cultural change elsewhere or ". . . in the realization that these resources could be collected on a large scale by means of new techniques" (ibid.).

Diffuse Cultural/Ecological Transition

The fifth postulate is distinctly unlike the four examples discussed previously. Implicit in the previous models is the assumption that there existed ethnic groups possessing territorial boundaries and distinctive cultural identities which functioned to set them apart in a more or less clear-cut manner. The existence of a strong ethnic identity on the tribal level is certainly an historical reality. Of necessity, tribes were demarcated by the fur trading companies for reasons of convenience and economy. The same is true of anthropologists and other individuals attempting to order trait lists and other data pertaining to various Native groups (see for example Wissler 1925). We grant that even in historic times, nowhere are ethnic or tribal boundaries clear-cut. We might argue, however, that the early practice of identifying, naming, and establishing tribal "trading chiefs" may well have added emphasis to ethnic boundaries which were previously much less well defined.

We can probably assume the reality of core groups associated with certain nuclear or ecological zones. Indeed, it is often the unique human adaptation to a specific ecological setting which serves to distinguish ethnic groups from one another. Although ethnic identity, territorial boundaries and subsistence strategies may vary independently, it is the character of ethnic division between Northwestern Plains and forest dwelling people which inhabited the regions adjacent the transition zone that is of primary concern here. It may well be, for example, that prehistorically, the ethnic transition between plains and forest dwellers was analogous to the diffuse, mosaic nature of the transition zone itself. Such a situation could result from the relative abundance of resources in the ecotone which might obviate rigidly defined and defended boundaries as in the Southwestern Chippewa example. An ethnographic situation which gives this model conceptual reality is Steward's (1955) study of the central Great Basin Shoshoni.

The use of the Great Basin Shoshoni model may not at first seem appropriate to our discussion of ecotonal borders. A few introductory remarks will clarify this point. Although the bulk of Shoshoni territory consisted of arid steppe which lies between 4,000 and 6,000 feet elevation, it is the relatively narrow piñion/juniper belt lying between 6,000 and 9,500 feet elevation which provided the Shoshoni with their most important subsistence resources, namely the piñon or pine nut. Above the piñon/juniper belt lay the zone of ponderosa pine and the habitat for deer and mountain sheep (Steward 1955:104).

Greater relative rainfall in the piñon/juniper belt produces greater variety of seeds, roots, grasses and game than is available in the adjacent steppe region. Interestingly, the all-important piñon/juniper belt is afforded the status of an ecotonal border, being transitional between the desert shrub and the alpine forest. It differs from the aspen parkland ecotone only in that it is an altitudinal rather than a latitudinal transition.)

During most of the year the Shoshoni nuclear family travelled alone or in the company of only one or two related families gathering available food resources (ibid.:105). Movement throughout the spring, summer, and fall were determined by the reports of good potential harvests to be had in various localities. Cooperative activities involving more than one family were very limited. In fall, each family arranged its travels so that it would arrive in the piñon/juniper zone by the first frost when the pine nuts would be ready for harvest. The harvest was cached and winter camps were established in the vicinity.

Simple as this seasonal cycle might seem, the annual movements of individual families were dictated largely by the food quest. The erratic occurrence of nearly all principal food resources and the competitive collecting of them, resulted in a very fluid socio-economic structure (ibid.:117). One of the results was the appearance of food-named groups. It was customary throughout the Shoshoni range to name groups occupying various locales by an important food resource which occurred there (e.g., Pine Nut Eaters, Ground Hog Eaters, Grass Seed Eaters, etc.) (ibid.). Steward's own statement fairly sums up the Shoshoni situation.

> Since there were no bands and no territorial limitations on movements in search of food, families frequently traveled from one food area to another and were known by the local name in each. Just as a Washingtonian today becomes a New Yorker upon living in New York, so a Ground Eater of western Idaho became a Salmon Eater if he moved to the Snake River.
> (Ibid.:116)

It is noteworthy that Thomas (1973), using a computer simulation of the central Great Basin Shoshoni subsistence/settlement pattern has verified Steward's model on the basis of archaeological data and indications are that the pattern persisted for at least 4,500 years (ibid.:173).

Any indigenous group located in the periphery of the plains or forest ecosystems adjacent to the transition zone, would have greater access to ecological diversity than would be possible in the plains or forest hinterland. Thus, for example, a family which by ethnic origin might possess technoeconomic expertise adapted to the mixed-wood forest ecosystem, would be quite able to exist in the familiar forest communities contained in the transition zone. Likewise, plains adapted groups could also find a living in the grassland component of the parkland.

An added feature of proximity to the parkland belt lies in the diversity of habitat and therefore the alternative subsistence resources available should one or the other commodity become scarce or fail. Similarly, the various grassland, aquatic, and forest communities might be exploited seasonally, each family band becoming "expert" in any one or all of the parkland resources but committed to none! The net result would be a loosely knit socio-economic pattern similar to Steward's Shoshoneon example in which family mobility is great over the relatively wide transition zone. Similar mobility is evident among the !Kung Bushman (Lee 1968:31).

The mosaic ecological diversity of the parkland as opposed to the piñon/juniper belt might be even less restrictive in terms of where a group might decide to winter or spend any other season. This mosaic pattern might then produce an ethnic pattern in which the cultural transition from forest to plains subsistence/settlement type might correspond more closely to the mosaic vegetation pattern than to the lines on Wissler's maps (cf. Hickey 1973).

In this example the cultural or ethnic identity of a particular group becomes rather arbitrary and depends upon the time of year the group is observed. The distinction between subsistence/settlement types exemplified in the adjacent regions becomes merely a matter of degree in the parkland itself. Reliance on one subsistence pattern or the other could change as readily as the seasons, and ethnic or tribal boundaries simply dissipate. Thus, we might imagine a gradual, diffuse cultural/ecological transition between forest and grassland ecosystems which coincides both in character and extent with the mosaic parkland transition. Emphasis on subsistence/settlement pattern could well vary directly with the density of forest and grassland communities in the ecotone. This pattern, in turn, might have little or nothing to do with language or ethnic origins of parkland inhabitants.

Summary-Discussion

In the foregoing discussion, five models or hypotheses have been generated from historical, ethnographical and archaeological data pertaining to transition zone subsistence/settlement systems. The five models have been referred to as (1) The Frontier Zone, (2) The Buffer or "Debatable" Zone, (3) Alternate-Seasonal Exploitation, (4) Exclusive Ecotonal Adaptation, and (5) Diffuse Cultural/Ecological Transition.

The next step in assessing the validity or applicability of any of these hypotheses in regards to the prairie-forest transition, is to deduce a set of predictions for each model. Following this, each model can be provisionally tested using data derived from the ecotone which is independent from those used to generate the models (cf. Williams et. al. 1973). Verification of any one set of predictions will indicate whether any of the hypotheses are useful in explicating past subsistence-settlement systems in the ecotone. In any case, the test will provide a basis upon which to generate additional hypotheses for further testing.

The Frontier Zone hypothesis is perhaps the least complex of the five models presented. Predictions which logically follow from this model would generally suggest a near or complete lack of archaeological materials within the ecotone. Ideally, this presence-absence criterion regarding archaeological remains would be applied separately to each of a series of temporal periods as opposed to the whole of prehistory. Archaeological and paleoecological research in the transition zone is not sufficiently advanced to allow realistic partitioning of time as related to known cultural periods. However, this vast prehistoric period could be divided into workable units using known climatic events or simply arbitrary time divisions. These units could then be refined as the research advances.

But perhaps more important to the verification of this model is the question why would such a no-man's land come to exist? The possible reasons for the avoidance of a region by human populations are as diverse as their susceptibility to testing. For example, it has been stressed throughout this thesis that the availability of a wide variety of resources is a fundamental characteristic of the transition zone. Therefore one of the causal factors which could initiate sustained withdrawal of human groups from the region would be a drastic decrease or disappearance of those resources.

Climatic fluctuation during the Holocene period is a common phenomenon and is one that is definitely susceptible to enquiry through one or more of the historical disciplines, e.g, palynology, paleobotany, paleontology, paleoecology, etc. Recognition of climatic change through fluctuations or disappearance of certain plants and other sedentary organisms, could be indicative of a general deterioration of the varied habitats which characterize the ecotone. More dramatic physical alterations of the environment such as glaciation, flooding, or subsidence are probably not applicable to the region during the Holocene, but are legitimate avenues of enquiry in this context nevertheless.

Whether due to physical or climatological factors, a reduction or deterioration of key habitat types would lead to a concomitant decrease in important animal and plant resources. Disappearance of certain resources from the transition zone might well prompt a hunting-gathering population to shift its range and thus vacate a portion of its former territory.

Other possible reasons for avoidance of a region might be due to cultural or psychological factors which, however valid in terms of the actual groups involved, could be very difficult to discover or demonstrate. The historical reality of an analogous situation is exemplified by the well-known Eskimo-Chipewyan avoidance pattern which existed (and to some extent still does) along the interface of their traditional territories.

Recognizing the existence of a frontier zone archaeologically should be feasible but testing for physical as opposed to cultural causal factors may be only partially successful. Under some circumstances disproof of physical or environmental parameters might be construed as weak proof for the presence of cultural factors as the cause for avoidance of a region. Perhaps then, other means could be devised to provide a more positive test (or tests) for verification of this class of elements.

Statement:

> The prairie-forest ecotone functioned as a frontier zone/no-man's land which served to separate two or more adjacent cultural groups during some specified time period.

Predictions:

(1) The existence of a frontier zone, uninhabited by any human population, will exhibit no archaeological remains for the period during which it continued to function as such.

(2) Enquiry into the causal factors responsible for avoidance of or withdrawal from a given area by a human population will reveal that one or more of the following elements was operative:

a) The region became uninhabited due to physical changes in the environment, e.g., glaciation, subsidence, climatic deterioration, overexploitation, etc.

b) The region became uninhabited due to cultural/psychological reasons, e.g., mutual fear and distrust, to avoid aggressive conflict, blood fued, suspicion of magical influence, witchery, etc.

The Buffer Zone hypothesis suggests that human occupation in the ecotone, as a contested zone, would necessarily be sporadic and temporary. Thus, site density would be expected to decrease abruptly as compared with regions flanking the transition zone. Fortified camps would appear common and occupations would be transient in nature. Male dominanted activities as reflected in artifact assemblages derived from these sites, would be dominant. Also sites occupied under these circumstances would be expected to occur on high ground where greater visibility would provide a measure of safety should rival groups be in the area. The use of fire for similar reasons might be minimal and the remains of hearths and meals would be equally sparse. Habitation per se would not be represented in the record.

Statement:

Two discrete cultural groups exploited the prairie-forest ecotone on a sporadic and temporary basis only as the need to acquire its resources dictated, the "need" being sufficiently urgent to reconcile the dangers inherent in doing so.

Predictions:

(1) The distribution of archaeological remains in the ecotone is relatively sparse as compared to the content of adjacent regions.

(2) Sites in the ecotone are commonly fortified or occupy strategic topographic positions as to increase visibility as a safety factor against discovery by a rival group.

(3) Site contents suggest male dominanted activities, i.e., hunting, war.

(4) Cultural remains in these sites are not abundant owing to the transient nature of the occupations.

The Alternate-Seasonal Exploitation hypothesis requires that two discreet prehistoric populations be identified within the ecotone at some given time period and that it can be shown that each group practiced patterned alternating seasonal occupation. To demonstrate that this hypothesis is at all applicable to the transition zone presupposes the presence of archaeological data.

Identifying the presence of two or more archaeological cultures in the ecotone might be done in a number of ways. For example, if the cultural traditions of prehistoric peoples adjacent to the ecotone are well known, then a traditional comparison of preserved cultural materials, dwelling types, or technologies could be used to confirm the presence of an extra-local human population. If this knowledge is not well developed, the approach must necessarily be much more abstract. For example, raw materials available only from localities outside the ecotone, if found in significant quantity, would provide circumstantial evidence initially for the presence of a group which originated elsewhere.

In this case the possible presence of trade systems must be recognized.

Using the direct historical approach, data regarding any number of cultural practices derived from historical references could provide an important source for identifying a particular cultural group in the transition zone. Although this approach is attended by some very complex problems in western Canada (Forbis 1963) its value as a legitimate avenue of research should not be underrated.

Determining the seasonal occupations of sites located in the ecotone may proceed according to established methods (see for example Ziegler 1973). Both plant and animal remains are among the most sensitive seasonal indicators but the possibility of food storage techniques which can complicate normal procedures should be borne in mind. The presence of migratory fowl, fetal skeletal material, the presence of shed antler as well as other seasonal biological developments and behaviour are among the most reliable of these indicators. The seasonal availability of plants (for consumption or ceremony) have similar implications for obtaining seasonality and these often require specialized recovery and analytical techniques (*cf*. Hole and Heizer 1973: 330-31).

Statement:

> Two or more discrete cultural groups exploited the ecotone during some given time period. Annual exploitation by each group was based upon alternating seasonal incursions for the utilization of some specific set of resources.

Predictions:

(1) Archaeological remains recovered from sites in the ecotone are sufficiently similar to remains from adjacent regions to define definite cultural affiliation.

-or-

There is sufficient similarity between archaeological remains and historically described cultural practices to warrant the tentative identification of a discrete culture (or cultures).

(2) A significant quantity of cultural remains (e.g., stone), have exotic origins, i.e., in localities away from the transition zone.

(3) Faunal remains by virtue of observed biological or inferred behavioural parameters indicate that occupation of any given group was seasonal.

(4) Examination of inferred seasonal exploitation patterns indicates that no two groups inhabited the ecotone simultaneously, i.e., occupation was alternating.

The Exclusive Ecotonal Exploitation hypothesis requires consideration of many of the same classes of data as does the previous model. However, unlike the previous model, a primary consideration is whether or not the archaeological remains are the leavings of a single and culturally distinct group as compared to the inhabitants of adjacent regions. This could be determined by a comparative examination of cultural remains both within and adjacent to the transition zone.

Floral and faunal indicators of seasonality will form the basic data for determining whether or not habitation was annually continuous. In this regard, the remains of "edge species" (an organism exclusive to the ecotone) may provide corroborative, but not conclusive, evidence for exclusive zonal exploitation.

Again, historical records could provide useful insight in predetermining the nature of archaeological subsistence-settlement patterns particularly with respect to their expression in the field.

Statement:

> Archaeological remains, i.e., artifacts, features, subsistence-settlement systems, pertaining to sites in the ecotone indicate that the prehistoric inhabitants were exclusively adapted to year-round utilization of transition zone resources for the time period indicated by those remains.

Predictions:

(1) Archaeological remains recovered from sites in the ecotone are sufficiently dis-similar from remains found in adjacent regions to define an exclusive cultural adaptation to ecotonal resources.

-or-

There is sufficient similarity between archaeological remains and historically documented cultural practices pertaining to the ecotone to identify an exclusive cultural adaptation and occupation.

(2) Cultural materials originating from outside the ecotone are present by virtue of trade and/or short term occupation of adjacent regions for the purpose of resource extraction.

(3) Faunal and botanical remains recovered from sites pertaining to the group in question exhibit biological or inferred behavioural characteristics which indicate that occupation of the transition zone was annually continuous.

The Diffuse Cultural Transition model is perhaps the most complex of the hypotheses presented due to potential overlap in some of the predictive criteria which must be considered. As with Steward's Shoshoni model, group mobility is great and subsistence shifts and social re-alliances frequent. As applied to the prairie-forest ecotone, this fluidity of socio-techno-economic expressions is the vehicle for a mosaic cultural intergrade analogous to the ecotonal resource pattern. Social or ethnic entities within the ecotone are envisioned as "impure" manifestations of cultural traditions present in regions adjacent the transition zone. Collectively they will form a blending of cultural traditions and practices but could appear, at least superficially, to relate to direct population incursions from outside the ecotone.

Seasonal shifts in subsistence-settlement strategies will be complete and may, for all intents and purposes, appear to be the result of seasonal use of specific resources by human populations originating from outside the ecotone. Model for model the greatest potential difficulty with respect to verification of this hypothesis, is with the Alternate-Seasonal Exploitation model. For obvious reasons, careful attention will have to be paid to the origin of cultural and raw materials as potential indicators of indigenous vs. non-indigenous exploitation. Disparities in any number of other cultural practices which find expression in the archaeological record may be useful in solving this potential problem. These might include butchering techniques, dwelling and hearth types, or stone working techniques. Obviously, a large body of comparative data will be required to obtain an adequate test of this model.

Statement:

Human subsistence-settlement systems as exemplified by archaeological remains in the ecotone represent a continuous blending of material and behavioural complexes defined in regions adjacent the ecotone.

Predictions:

(1) Archaeological materials present in the ecotone form an intergrade with respect to known archaeological assemblages assignable to cultures found in regions adjacent the transition zone.

(2) An intermingling of material types, technologies and other durable remains of cultural practices suggest cultural affinities with adjacent human groups; affinities which may be inversely proportional to increasing distance between a site and an adjacent cultural region.

(3) Quantitative or qualitative differences in archaeological assemblages in the ecotone are the result of changing seasonal subsistence strategies and/or group re-alliances which have the effect of making these assemblages appear more or less similar to those of adjacent regions.

(4) Although specific site occupations are expected to be seasonal, they should collectively exhibit continuous annual use within a defined geographical range. Seasonal shifts in subsistence-settlement strategies will be the result of a single broad-spectrum cultural adaptation in which group mobility, and hence archaeological variability, is great.

(5) Biological and behavioural parameters observed in faunal and botanical remains will show marked seasonal shifts in subsistence-settlement strategy and will provide some control for the basis of these shifts.

(6) Resources available only from regions outside the transition zone (if present) will exhibit a decrease in relative abundance proportional to increasing distance from their source.

Having outlined the fundamental implications for each of the five models for human utilization of the prairie-forest ecotone, the discussion may proceed to examination of relevant archaeological data in order to perform provisional tests of each of the hypotheses. These data are independent of those used to generate the models and the use of them, therefore, is consistent with the theoretical procedure outlined earlier in this thesis.

It should be noted that some of the predictions derived from the models (e.g., seasonal vs. annual resource exploitation), are not mutually exclusive. Therefore, verification of a particular model may require that a combination or "set" of implications be satisfied before any given hypothesis is supported.

Following the presentation of archaeological data, an attempt will be made to link independent historical data concerning subsistence-settlement systems which may have a bearing upon the verification of a model. As this is a provisional examination of a wide range of facts and observations, it should not be a complete surprise to find that no single model is completely satisfied with respect to the predictions or implications which follow from it. The results, it is hoped, will provide a first approximation of the transition zone subsistence-settlement system(s) pertaining to the prehistoric period. Further data will no doubt allow elaboration of the models and additional predictions to be generated with which to add greater detail and understanding of these prehistoric cultural systems.

CHAPTER IV

ARCHAEOLOGICAL FAUNAL ASSEMBLAGES FROM SITES IN THE TRANSITION ZONE

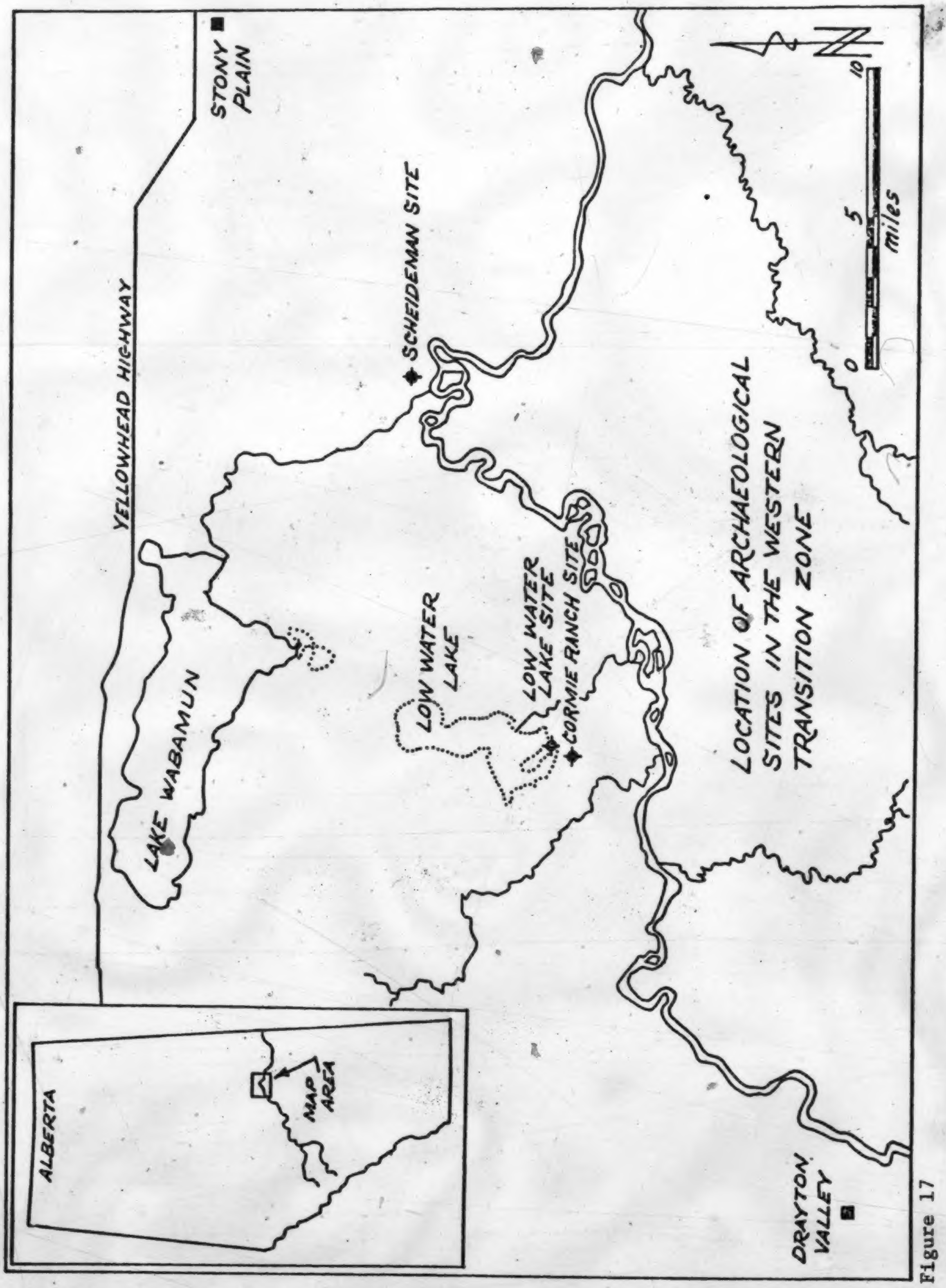
Introduction

This chapter describes the faunal remains recovered from three prehistoric sites in the western transition zone. The materials span a period of approximately 3,300 years from 2,500 B.C. to A.D. 855. Species types, their spatial distribution, and individual and minimum counts are discussed with respect to specific features as well as to the assemblages as a whole.

The discussion includes description of each site, the excavation strategy, feature distribution and stratigraphy. Other artifacts such as stone and bone tools are only superficially dealt with as most of this data has been presented elsewhere (Losey 1972). Geographic locations of sites are shown in Figure 17.

Cormie Ranch Site/FiPp 300

In June 1969, the Provincial Museum and Archives of Alberta, Human History Division, sponsored a month long archaeological survey of shorelines surrounding now extinct Low Water Lake (Fig. 17) (Losey 1970). The former water body is located 45 miles west/southwest of Edmonton, Alberta in Township 51, Range 4-5, west of the fifth Meridian. It occupied an area of approximately 5,000


YELLOWHEAD HIGHWAY
STONY PLAIN
SCHEIDEMAN SITE
LAKE WABAMUN
LOW WATER LAKE
LOW WATER LAKE SITE
CORMIE RANCH SITE
0
5
10
miles
N
ALBERTA
MAP AREA
DRAYTON VALLEY

LOCATION OF ARCHAEOLOGICAL SITES IN THE WESTERN TRANSITION ZONE

Figure 17

acres prior to being artificially drained in the late 1920's. The lake shores were confined within a former ice-marginal drainage system and is thus of post-glacial origin (St. Onge 1972:5-6 & fig. 3).

A number of prehistoric sites were recorded as a result of the 1969 survey; the most important of which is the Cormie Ranch Site (Losey 1972). The site rests on an extinct beach on the southern shoreline of Low Water Lake, latitude 53°25'46"N and longitude 114°36'52"W (NE 35-51-5-5). It is a stratified three component site, the two lowest levels of which were deposited within wind borne sand of beach/dune origin. These levels contain several kinds of activity areas related to the butchering and processing of bison. The uppermost level has a distinct faunal assemblage and environment of deposition. Full scale excavation of the site was completed in 1970, under contract with the National Museum of Man, and with aid from the University of Alberta and the Provincial Museum of Alberta.

The Cormie Ranch Site is bisected by a municipal road running north-south through the beach ridge and former shoreline. The beach ridge itself terminates about 750 meters east of the road where it becomes low and indistinct. The road access is 20 meters wide and has completely removed an estimated 40 percent of the site. The area west of this roadway (Location I) was the most productive (Fig. 18).

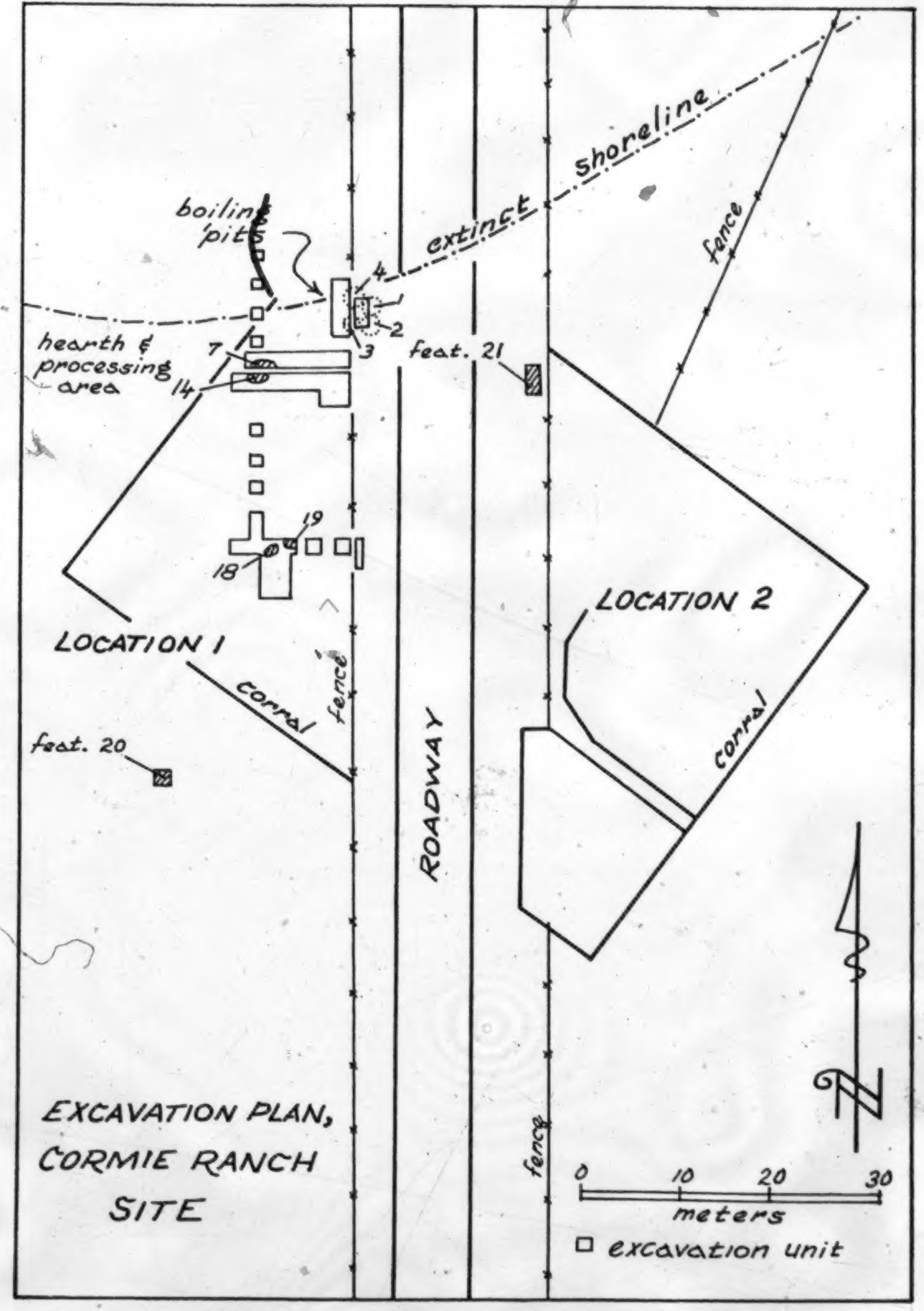

boiling pit
extinct shoreline
fence
4
1
2
3
hearth & processing area
7
14
feat. 21
19
18
LOCATION 1
LOCATION 2
corral
fence
ROADWAY
feat. 20
corral
fence
N
EXCAVATION PLAN, CORMIE RANCH SITE
0
10
20
30
meters
□ excavation unit

Figure 18

Extensive excavation in Location I exposed a series of horizontally bedded wind deposited sand strata that were laid down in what appears to have been a blowout subsequently leveled by the redeposition of locally derived material. The archaeological remains are sandwiched between these strata.

Generally these strata grade from coarse, water-laid sand at the base of the beach ridge (about 125 cm below surface), to finer sand with an increasing silt fraction nearer the surface. Prior to recent clearing, the modern surface supported a mixed-wood forest type with a leaf litter horizon approximately 8 to 10 centimeters thick. The soil profile is otherwise poorly developed being generally classified as regosolic (Lindsay *et. al*. 1968).

Cultural Remains

Three distinct living floors were isolated during the 1970 excavations. Level 1 is contained within the basal portion of a thick leaf litter horizon (Lh) deposited on a mixed-wood forest floor. This level is poorly defined due to the sporadic occurrence of the forest horizon. Much of the litter zone has been removed by recent clearing in the immediate area to provide pasture land.

Level 1 -- Where it does exist, Level 1 contains the disarticulated remains of Wapiti (*Cervus sp*.) including fragments of an inominate, radius, ulna, tibia, and ribs (Table 3). The ribs are associated with a small hearth about 45 centimeters in diameter. The hearth also contains a small quantity of calcined,

Table 3

Faunal Remains from Level 1 of the Cormie Ranch Site

Site FiPp 300/Level 1/Wapiti

Element	Number
Left inominate	1
Left tibia (shaft)	1
Left radius (proximal)	1
Left ulna (proximal)	1
Lumbar vertebra (fragment)	1
Cervical vertebra (fragment)	2

Minimum number = 1

unidentifiable bone fragments. A simple quartzite projectile point was recovered from this horizon but not in direct association with the other remains. A bone apatite date derived from the fragmented radius yielded an age range of 1,095 ± 130/A.D. 855 (S-684,NMC-471).

Level 2 -- Cormie Ranch Site Level 2 is distinct and perhaps unique when compared to many other known sites in the region. Nearly all of the 900 square meters excavated yielded archaeological data, and bone preservation is excellent despite relatively shallow burial. Several discrete features and activity areas were defined which include hearths, butchering areas, chipping areas, a stone cache, and bone boiling pits. Of these, only the butchering features (7, 14 and 20) and the bone boiling pits (features 1-4) will be dealt with here as these contain all of the diagnostic faunal material. Artifact types and distribution are described elsewhere (Losey 1972).

Butchering Features -- Three butchering areas were isolated in the excavation, two of which (features 7 and 14) are contained in a general "kitchen" area. The basic units of identification for this activity area are (1) the presence of at least five small hearths lined with unidentifiable calcined bone, and (2) clusters of bone elements representing large portions of butchered bison.

Feature 7 is a cluster of pedal bones representing the left and right front limbs (butchering units) of bison. Feature 14 is a concentration of lower limb bones representing the left rear quarter of bison. Feature 20 is located some 400 meters south (inland) from the kitchen area and is a butchering unit comprised of the front left quarter of bison including the vertebral column (cervical and thoracic vertebrae) and cranium less the mandible (Table 4).

A minimum count for all three features is two individuals based on the presence of two 2nd-3rd carpi (Table 4). Features 7 and 14 probably represent the remains of a single individual simply distributed around two separate processing areas.

Bone Boiling -- Excavations also revealed the remains of four bone boiling pits located on the sloping fore-beach near the former shoreline. These bowl shaped features were excavated into the sandy sub-soil to a depth of 50 to 60 centimeters below the surface, lined with a waterproof membrane (perhaps a green hide), and filled with water which was boiled by the addition of hot stones (cf. Leechman 1951). The comminuted skeletal remains of bison including limb and pedal bones, vertebral, cranial, and dental fragments were placed in the boiling pits to render their grease content. The large majority of the comminuted bone would pass through a one-half inch mesh, thus only a fraction of the material could be identified.

Due to a differential moisture content, Feature 1 provides an excellent profile of the boiling pit configuration (Fig. 19). A large stone "hammer" along with a few complete bone elements were recovered from this feature. A total of 28 pounds (12.7 kg)

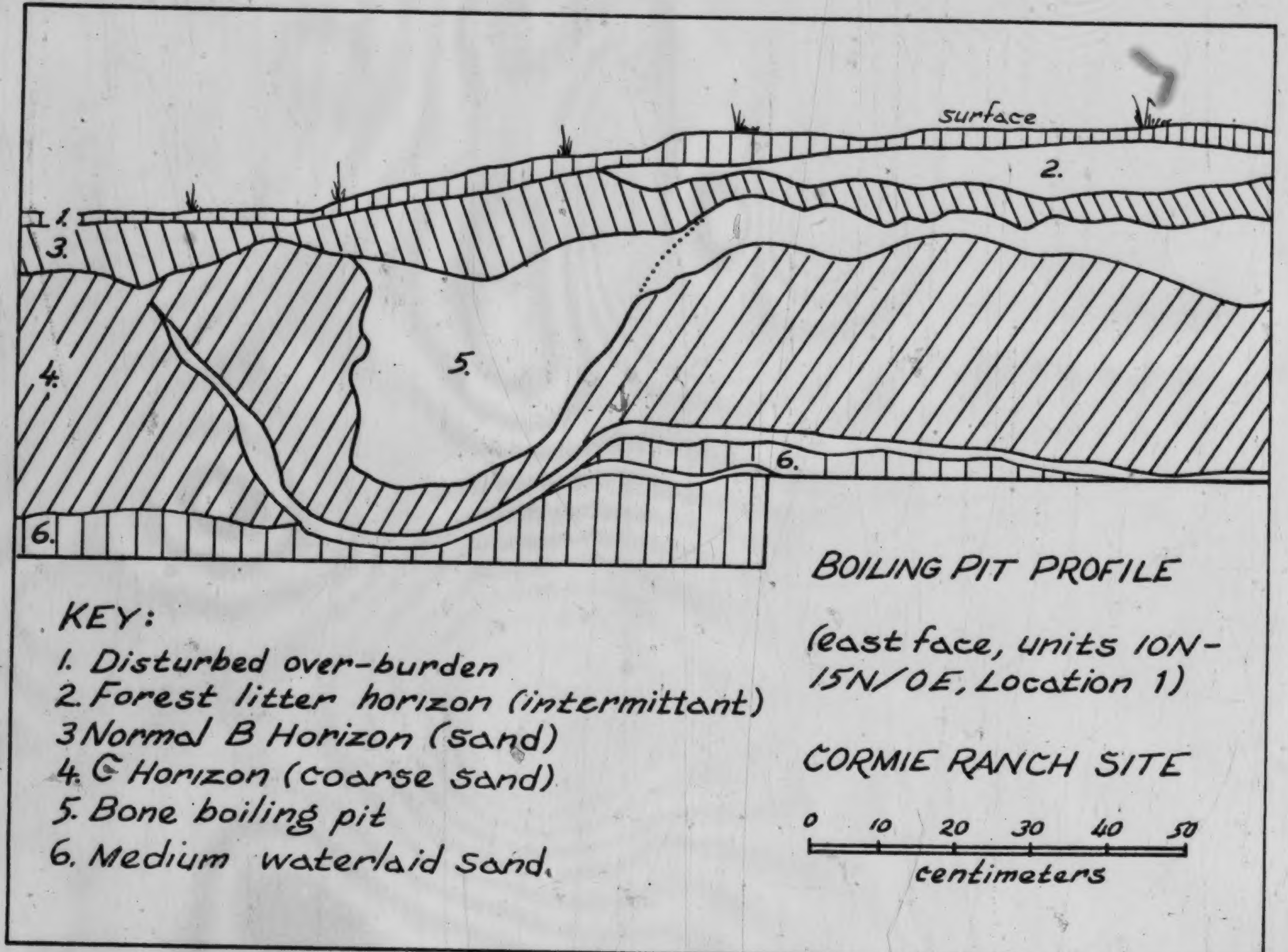

surface
1.
2.
3.
4.
5.
6.
6.
6.
BOILING PIT PROFILE
(east face, units 10N-15N/0E, Location 1)
CORMIE RANCH SITE
0 10 20 30 40 50
centimeters
KEY:
1. Disturbed over-burden
2. Forest litter horizon (intermittant)
3 Normal B Horizon (sand)
4. C Horizon (coarse sand)
5. Bone boiling pit
6. Medium waterlaid sand.

Figure 19

of bone was recovered from Feature 1; 4 pounds 3 ounces (1.9 kg) of which was identified.

Feature 2 was nearly intact having been only slightly disturbed by road building activities. In spite of this, however, only 1 pound 10 ounces (737 gr) of faunal remains were recovered, 2 ounces (56.7 gr) of which could be identified.

Since approximately 50 percent of Feature 3 was destroyed in road construction, the sample of bone must represent about one-half of the original content. A total of 5 pounds 13 ounces (2.64 kg) of bone was recovered, 9 ounces (255.1 gr) of which was identified.

Feature 4 is defined by a semi-circular arrangement of bone fragments situated around the lip of the boiling pit. Although only one-half of this feature was excavated, 11 pounds 14 ounces (5.4 kg) of comminuted bone was obtained, but only 2 ounces (56.7 gr) could be identified. A radio carbon date obtained from charcoal at the bottom of Feature 4 yielded an age range of 1,345 ± 61/A.D. 605 (BGS80-NMC-466).

The minimum count of bison represented in the Level 2 component is seven individuals (Table 4 , based on the remains of seven left metatarsi in Features 1, 2, 3 and 14. The complementary distribution of elements recovered from the boiling pits (Features 1-4), primarily pedal bones, is strong evidence for the contemporaneity of these features. Thus, the date of A.D. 605 ± 61 years is considered valid for the entire component.

Table 4

Faunal Remains from Level 2 of the Cormie Ranch Site

Site FiPp 300/Level 2/Bison

	Feature													
	1		2		3		4		7		14		20*	
Element	L	R	L	R	L	R	L	R	L	R	L	R	L	R
humerus									1				1	
radius ulna	1	2		1	3				1				1	
radial carpal	1	1	1	1			1			1				
ulnar carpal	1	1			1					1				
2-3 carpal	1	1			1	1			1	1			1	
Intermed. carpal			1		1					1				
4 carpal	1			2	1		1			1				
metacarpal	1	1				1				1				
1st phalanx														
2nd phalanx														
3rd phalanx														
femur														
tibia-fibula		1		1	1	1								
lateral maleolus	1	2			2	2					1			
2-3 tarsal	2	2					1				1			
C-4 tarsal	2	2			1	1					1			
tibial tarsal	2	1	2	2	2									
fibular tarsal	1	2			1	1				1	1			
metatarsal	$\boxed{2}$		$\boxed{1}$		$\boxed{3}$	1					$\boxed{1}$			
1st phalanx					1									
2nd phalanx														
3rd phalanx														
	2		2		3		1		1		1		1	

**Minimum number = 7

*Note: also recovered from feature 20 were a scapula, five ribs, vertebral, and cranial fragments less mandible indicating the presence of a more or less complete front left quarter of bison in articulated anatomical position.

**Matching the elements obtained from each feature results in a minimum number of seven individuals whereas the sum would otherwise equal 11.

$\boxed{n}$ Element used to determine minimum number.

Level 3 -- Level 3 at the Cormie Ranch Site occupies the very bottom of the basin or blowout on the former beach ridge and is therefore encountered at various depths over the site ranging from 30 to 80 centimeters below surface. All of the faunal remains recovered from this component represent bison and three features are present. Features 18 and 19 are located in the north half of a large excavation unit west of the roadway between 28 and 32 centimeters below surface. The only identifiable fragments from this location are portions of a rib, tibia, and humerus, three carpi, and a tarsal bone (Table 5). Two small clusters of calcined bone fragments suggest hearth activity and the presence of a retouched flake, projectile point, and chipping detritus supports its cultural origin.

Feature 21 is located in two continuous excavation units immediately east of the roadway (Location 2) at a depth of 65 to 85 centimeters below surface. Here a butchering feature comprised of a fragmentary atlas, humerus, scapula, carpus, metacarpal, tibia, tarsus, metatarsus, and three phalanges representing a minimum of two individual bison (Table 5) was unearthed. A large flake knife and stone anvil surrounded by dental fragments were also present. An individual count for the entire component is three based on the presence of three right 2nd-3rd carpal bones. Features 18 and 19 are probably represented by a single individual whose remains are simply distributed between two discrete clusters.

A bone apatite date derived from unidentified material

Table 5

Faunal Remains from Level 3 of the Cormie Ranch Site

Site FiPp 300/Level 3/Bison

Element	Feature					
	18		19		21	
	L	R	L	R	L	R
scapula					?	
humerus			1		*1	
radius ulna			1			
radial carpal		1			1	
ulnar carpal					2	
2-3 carpal		$\boxed{1}$	1			$\boxed{2}$
Intermed. carpal						
4 carpal					1	
metacarpal					1	
1st phalanx						1
2nd phalanx						2
3rd phalanx						
femur						
tibia-fibula	1					1
lateral maleolus						
2-3 tarsal						
C-4 tarsal		1				
tibial tarsal					1	1
fibular tarsal						
metatarsal						2
	1		1		2	

Minimum number = 3

*Note: also recovered were fragments of dentition and an atlas.

$\boxed{n}$ Element used to determine minimum number.

from Level 3 yielded an age range of 4,000 ± 120 years/2,050 B.C. (NMC-465) and on carbonaceous residue after strong acid treatment 4,490 ± 190 years/2,540 B.C. These dates are in line with the known age range of the single McKean projectile point recovered from this component (Sims 1970:130). Seven other projectile points tending toward corner removed notching are enigmatic with respect to this early date (Losey 1972:Fig. 12).

Low Water Lake Site/FiPp302

This site is located on the southern shoreline of an elongate land form which was formerly an island within now extinct Low Water Lake, Alberta. The island, trending northwest by southeast, is approximately 1.6 km long, 0.4 km wide and rises to a maximum height of 754 m AMSL. The land form is underlain by Paleocene sandstone bedrock mantled by a complex series of glacio-fluvial, eolian, and lacustrine sediments. The precise location of the site is 53°22'15" north latitude and 114°36'00" west longitude (NE-NE-35-50-5-W5).

The site was initially discovered in the course of an archaeological reconnaissance of the Low Water Lake area described previously. Artifacts were found exposed in a lane which connects the island and Cormie Ranch Southend headquarters with the township Correction Line Road. Both lithic materials and sparse faunal remains were noted on the surface and additional material was obtained when the site was tested in 1970.

Full scale excavations were undertaken from May through July of 1972, with financial assistance from the Provincial Museum and Archives of Alberta. The site was conveniently divided into an east and west locality by the transecting driveway. Excavation in the lane itself was not possible owing to frequent vehicular traffic (Fig. 20).

The stratigraphy is relatively simple with the exception of the near-shore zone where the waterlogged substrate has been subjected to frost heaving and amphibious rodent burrowing which has resulted in numerous collapsed features. Otherwise the deposit appears to be a single component contained within a sandy eolian soil. Site burial is quite shallow depending on the particular area and the degree of surface disturbance.

Cultural Remains

In general the archaeological remains are contained within the upper 15 cm of soil except where features such as cooking or boiling pits extend through the living floor to various depths.

Location 1 (west of the lane) at first appeared to have the least potential with respect to preservation of in situ remains owing to the presence of a nearby well site and the traffic, both animal and vehicular, which attends it. In some instances compression resulting from vehicular traffic brought prehistoric and recent cultural material into direct contact. At the same time, tailings from the well site served to protect other areas of this locality.

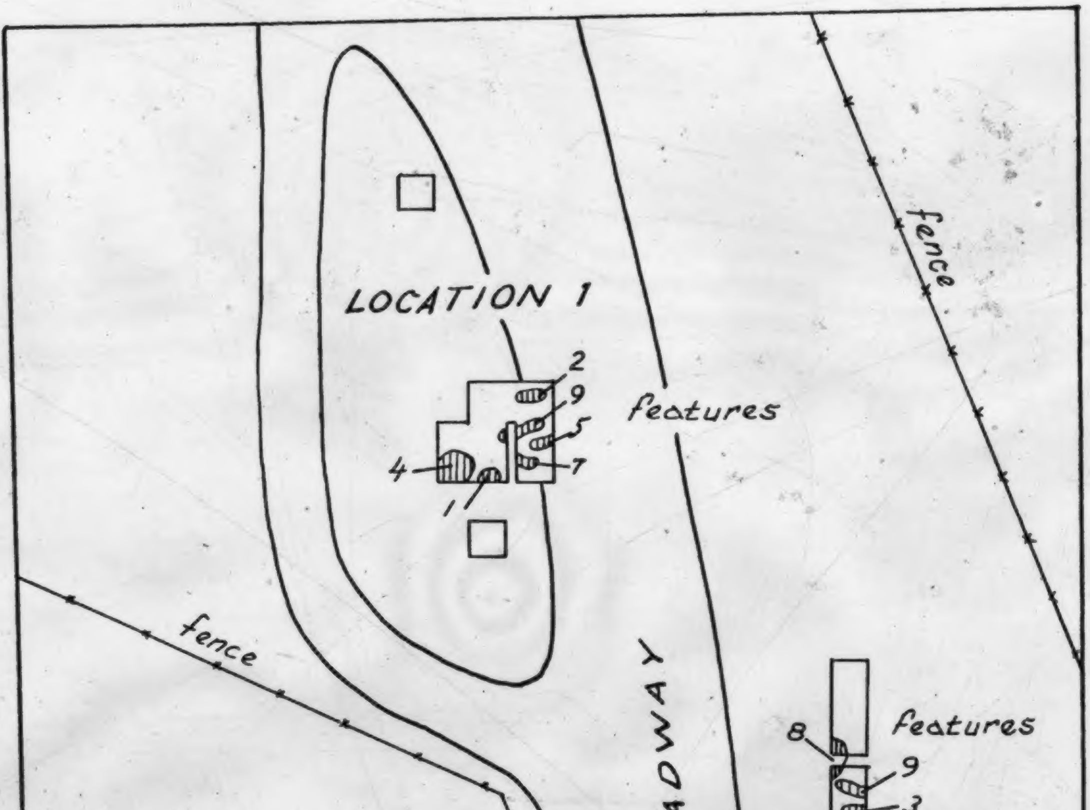

LOCATION 1
2
9
5
7
4
1
features
fence
fence
ROADWAY
features
8
9
3
LOCATION 2
6
hearth
EXCAVATION PLAN,
LOW WATER LAKE SITE
0
5
10
15
meters
excavation unit

Figure 20

Ten 1.5 meter squares were ultimately excavated in Location 1, eight of which were contiguous forming a larger unit 18 square meters in area. Six features (Features 1, 2, 4, 5, 7 and 9) four of which are hearths, were located in this single area. Three of the hearths are irregular-elongate areas of very dark carbonaceous sand containing burned and calcined bone, fire-cracked-rock, artifacts, and chipping detritus. The fourth hearth has similar attributes but lacks the dark staining.

Two other features (Features 1 and 5) are discrete areas of bone and lithic artifacts peripheral to the hearths. Feature 1 is a group of tools consisting of a scraper, bone awl, perforator, and a ground stone object located between two of the hearths (Features 4 and 7). Feature 5 is a small concentration of chipping detritus, a biface, and two projectile points associated with a hearth (Feature 7).

Another area in Location 1 which contains considerable chipping detritus is associated with Hearth Feature 4. It contains a large 'chopper', a core, and a retouched flake. This area completely filled the floor of a 1.5 meter unit and thus had no definable limits. Two other tools, a utilized cobble spall, and a biface were associated with Features 9 and 2 respectively.

Faunal remains from Location 1 by minimum count include one muskrat (Ondatra zibethicus), one Wapiti (Cervus canadensis), one moose (Alces alces), and three beaver (Castor canadensis) (Table 6).

Table 6

Mammalian Remains from the Low Water Lake Site

Element			Bison		Wapiti (Location 1)		Moose (Location 1)		Deer		Bear		Fox		Beaver (Location 1)		Muskrat (1 from Location 1)		Hare		Skunk		Canis	
			L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
Scapula		complete																						
		fragment													1	1			1	1				
Humerus		complete																						
		proximal	1												2	2								
		distal		1													1	1	2	1				
Ulna		complete																						
		proximal												1	1	2	1	1		$\boxed{3}$				
		distal	1												1									
Radius		complete																						
		proximal				1								1	$\boxed{3}$	2								
		distal	1	1											1	3								
Carpus	radial		1	1				$\boxed{1}$								1								$\boxed{1}$
	ulnar			1									$\boxed{1}$		2									
	accessy		1	1											1									
	⌈intermed		1	1																				
	⌊first																							
	⌈second		1	1																				
	⌊third														1	1								
	fourth		1	1	$\boxed{1}$										1									
Metacarpus		complete													2	1								
		proximal	$\boxed{2}$	2					?						1	1								
		distal																						
Femur		complete												1			1	1						
		proximal							$\boxed{1}$								4	$\boxed{6}$	1	2				
		distal													1			1				?		
Patella															?	1			?					
Tibia		complete																						
		proximal													1	1	3	4						
		distal						1							1		3	5		3				
Fibula		complete																						
		proximal																						
		distal													1	1								
Tarsus	l.maleolus			1				1																
	tibial														1	1	1		1					
	fibular			1									1				1	1	2	1				
	first														1	1								
	⌈second														2	3								
	⌊third															1								
	⌈central			1											2	1			1					
	⌊fourth														2	1								
Metatarsus		complete																						
		proximal		1											2	2				3				
		distal																						
Cranium				X												X		X		X				
Antler/Horn Core																								
Mandible			1	1									1				4	2	3	1				
Atlas																								
Axis			2																					
Cervicals				14										2			2							
Thoracic																8		4		1				
Lumbar																11		2		2				
Sacrum																								
Pelvis	ischium														1		1	3	1	1				
	illium			1														1						
Caudal														?		1		9						1
Phalanges				8				3		2				1		8		3		6				
Sesamoid								1								5								
Total Specimens*			57		2		7		4		-		10		94		66		38		1		2	
Minimum Number			2		1		1		1		-		1		3		6		3		1(?)		1	

*Count does not include cranial fragments.

$\boxed{n}$ Element used to determine minimum number.

Muskrat remains consist of a left tibia and a caudal vertebra widely separated and with no definite association to any feature. The remains of Wapiti include a fragmentary right radius, an acetabulum, and a tibial tarsal recovered from the periphery of Feature 4. Moose remains represented by a right lateral maleolus and a fragmentary tibia were associated with Feature 2. Feature 4 is comprised entirely of charred and calcined skeletal remains of the three beaver (Table 6). The presence of numerous metapodial epiphyses (N = 22) suggest at least one immature individual.

Excavations in Location 2 (east of the lane) were concentrated in two major areas (Fig. 20). One is on the gentle slope which extends from the extinct shoreline to the lip of a small bench-like area some 30 meters inland. Five 1.5 meter units arranged along a north-south baseline coordinate were excavated there. The other area is immediately adjacent to the former shoreline where two contiguous three meter units were excavated. Two narrow exploratory trenches extending east and south from the latter units were also excavated bringing the total area investigated to just over 32 square meters.

Lithic artifacts and faunal materials recovered or exposed in five excavated units along the baseline coordinate consist primarily of lenticular concentrations or scatters. Three features (3, 8 and 9) were located in this area. Feature 3 is a concentration of bone elements representing the lower portion of a bison right rear limb at a depth of 30 cm below surface (Table 7). The comminuted condition of the faunal remains and the resultant profile of this feature strongly suggests a bone boiling pit. Feature 8 is a small cluster of large bird remains, possibly goose (Table 8), associated with a quantity of fire-cracked rock. Feature 9 is a trough- or trench-like depression containing the remains of the pelvic limbs of a beaver at a surface depth of 40 cm (Table 9). Other fauna includes muskrat, hare, fish, mice, Bald Eagle, and waterfowl (Table 10).

Lithic materials include a very small amount of chipping detritus and a perforator recovered in two fragments. Neither of these is associated with the aforementioned features. One other area of interest is an infilled rodent burrow containing the remains of 13 ground squirrels which were probably asphixiated during a fire which swept the island in 1945.

Excavation of the two contiguous three meter units in the near shore zone revealed a very complex deposit. Severe and widespread disturbance due to frost action in the previously waterlogged substrate has resulted in a highly convoluted surface. Tunnels and burrows of muskrat and beaver have also disturbed the archaeological deposits. Together, these agents have formed miniature catchments in which artifacts and organic debris have accumulated. When excavated these appear as dark, artifact bearing "pseudo features".

One hearth (Feature 6) was recovered in this area. It

Table 7

Bison Remains from Feature 3, Location 2, Low Water Lake Site

Site FiPp 302/Feature 3/Bison

Element	Number
Right metatarsal (Prox.)	1
Right C. & 4th tarsal	1
Right lateral maleolus	1
Right fibular tarsal	1
--- vertebral processes	10
--- tooth enamel sheaths	(fragments)
--- 1st cervical vertebra	1 (fragments)

Minimum Number = 1

Table 8

Large Waterfowl Remains from Feature 8,
Location 2, Low Water Lake Site

Site FiPp 302
Large Waterfowl (cf. Canada Goose)

Segment	Element	Number
Axial		—
Pectoral Limb	left humerus (proximal)	1
	--- humerus (shaft)	1
	radius	1
	--- radius (shaft)	2
	right radiale	1
	right ulnare	1
	left metacarpal	1
	right metacarpal	1
Pelvic Limb	--- femur (shaft)	1
	left tibiotarsal (proximal)	1
	left titiotarsal (distal)	1*
	--- tarsometatarsal (distal)	1
	--- tarsometatarsal (shaft)	1

Minimum Numner = 1

*Shaft fragment also present.

Table 9

Beaver Remains from Feature 9, Location 2, Low Water Lake Site

Site FiPp 302/Feature 9/Beaver

Element	Number
Left femur (distal)	1
Right (?) femur (prox.)	1
Left tibia (prox. frags.)	1
Right tibia (med.)	1
Left acetabulum	1
Right acetabulum	1
2nd ant. phalanx	1
Rib (proximal)	1
Vertebral fragments	(53)

Minimum Number = 1

Table 10

Waterfowl Remains from Location 2, Low Water Lake Site

Site FiPp.302
Small Waterfowl (Mallard size or less)

Segment	Element	Number
Axial	sternum	3
	keel	3
Pectoral Limb	left scapula (proximal)	1
	right scapula (proximal)	2
	left humerus	1
	left humerus (shaft)	1
	left coracoid (distal)	2*
	right coracoid (proximal)	3**
	left metacarpal (proximal)	1
	right 1st phalanx	1
Pelvic Limb	left tarsometatarsal	1

Minimum Number = 3

*left proximal fragment also present.

**right distal fragments also present.

consists of a dense concentration of burned and calcined bone among which are the remains of a deer (Odocoileus sp.). Associated with this hearth are three retouched flakes and considerable chipping detritus. Materials recovered elsewhere include a biface fragment, an endscraper, and the remains of bison, a canid, beaver, muskrat, hare, large and small waterfowl, ground squirrel, mice (intrusive), and a quantity of eggshell fragments.

No features were recovered in either of the two exploratory trenches, but dark organic stains persisted all the way to the shore zone where peaty material was encountered. Artifacts recovered include two projectile point fragments, two large retouched flakes, numerous unaltered flakes, and chipping detritus. Faunal remains include bison, beaver, muskrat, hare, small waterfowl, grouse (?), mice, and eggshell fragments. Age determination by carbon-14 assay based on charcoal obtained from Feature 2, Location 1, is 1,360 ± 80 years/A.D. 580 (GAK 5436).

Scheideman Site/FiPn 102

In June of 1968, a brief site survey was conducted in the vicinity of Mewassin, Alberta, between the North Saskatchewan River and the northern boundary of Township 51, Range 3, west of the fifth meridian (Losey & Losey 1969). The general area, and particularly the paleontological bison site (Hillerud 1966) located in lacustrine sediments exposed by the meandering river, has long been of archaeological interest due to the potential presence of very early post-glacial human activity. Scanty evidence of cultural association with the 8,000 to 9,000 year old remains of extinct bison served as a focal point for the site survey. The survey and preliminary testing was supported by a University of Alberta Faculty Research Grant to Dr. Ruth Gruhn.

During the course of the six week survey, several localities were visited and tested and many private collections were examined. It soon became apparent that archaeological materials in the area ranged from at least 6,000 B.C. to early 19th Century fur trade activity. Of particular interest, however, is the locality which occupies an ancient meander core elevated some 15 to 30 meters above the valley floor (777.25 m AMSL). This land-form is isolated from the adjacent uplands by the river itself to the south and a former channel which swings around to the east, north, and west. This meander core is comprised of nearly 500 acres of relatively flat terrain, most of which is under cultivation. At least one third of the total area has yielded archaeological material.

Cultural Remains

The largest continuous distribution of material is located in the southern portion of the meander core in SE 25-51-3-W5 (Latitude 53°21'49"N, Longitude 114°17'26"W) where several hundred chipped stone artifacts were observed in freshly plowed fields. Testing in several areas during 1968 and in the latter half of the 1969 field season, did not, unfortunately, locate any extensive areas of undisturbed materials. Excavation in areas where material is abundant indicated that site burial does not exceed the active plow zone (about 20 to 25 centimeters). Testing of very limited undisturbed areas bordering the cultivated field was successful in locating one small locality at the extreme east end of the meander core where a few centimeters of slopewash, buried and protected approximately 18 square meters of a moderately productive living floor (Fig. 21).

Research at the Scheideman Site was accomplished largely through the efforts of students enrolled in the University of Alberta, Department of Extension Archaeology Methods course conducted on the site. Excavation of eight contiguous 1.5 meter units secured a small but diagnostic assemblage of faunal material (Table 11). The remains of bison (Bison sp.), Moose (Alces alces), and Fox (Vulpes fulva) representing one individual each were recovered from three excavation units. Bison remains represented by a lower third molar, and moose by a second phalanx and a vertebral fragment, occurred together in Unit C4. In Unit B4 bison was represented by a lower first molar and fox by the ulna, humerus, metacarpal, two phalanges and a caudal vertebra. The third unit (B2) was the site of a bison right radius (fragment) and a right intermediate carpal bone. The very fragmented condition of the total ungulate sample suggests that bone boiling may have been an associated activity. It is difficult to know whether the fox was used as a food resource but it should be noted that various canidae are often common in plains sites

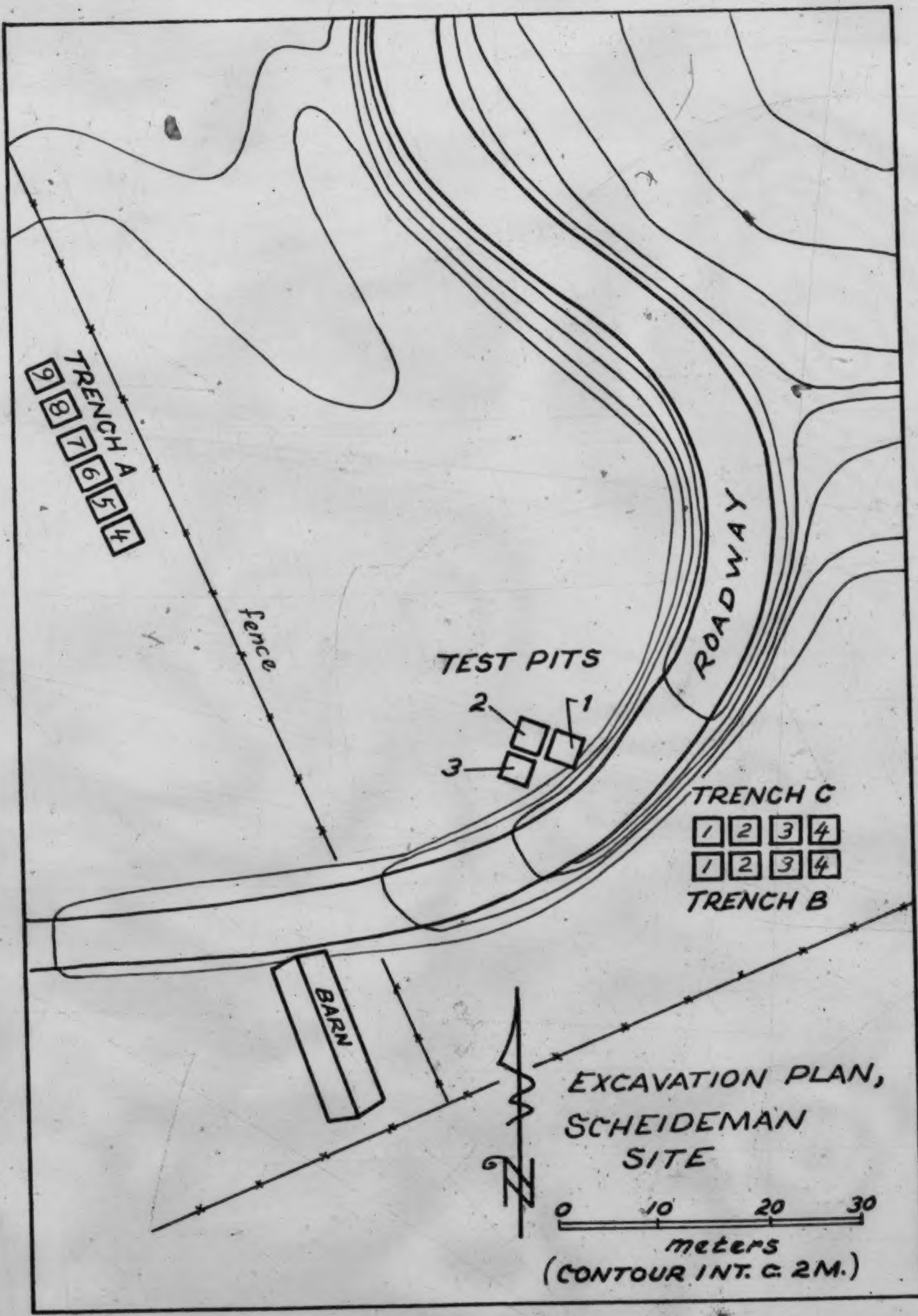

TRENCH A
9
8
7
6
5
4
fence
TEST PITS
1
2
3
ROADWAY
TRENCH C
1
2
3
4
1
2
3
4
TRENCH B
BARN
EXCAVATION PLAN,
SCHEIDEMAN
SITE
0
10
20
30
meters
(CONTOUR INT. C. 2M.)

Figure 21

Table 11

Ungulate Remains from the Scheideman Site

Site FiPn 102/Mammalia

Element	Number
Bison *Bison bison*	
right radius (distal)	1
right intermediate carpal	1
right 3 Molar	1
right 1 Molar	1
— tibia (shaft)	1
	Minimum Number = 1
Moose *Alces alces*	
2nd phalanx, ant./lat.	1
thoracic vert., sup. spine	1
	Minimum Number = 1
Fox *Vulpes fulva*	
left ulna (proximal)	1
left humerus (distal)	1
left metacarpal 2	1
left phalanx	2
-- caudal vertebra	1
	Minimum Number = 1

containing bison remains (cf. Dyck 1972; Sims 1974).

Hearth activity at this site was apparently widespread as indicated by the quantities of fire-broken rock distributed in eight of the eleven test excavations; at least 2.2 kg were recovered. Hearth-like features were suggested in many cases by irregular areas of very dark soil containing charcoal flecks and bits of burned or calcined bone. The depth of many such features was so shallow, however, as to preclude any accurate description of morphology. Most are best described as ephemeral scatters.

Two features found in Test Pit 1 are reminiscent of the roasting pits observed at the Low Water Lake site. They differ mainly in their circular to ovoid outline form as opposed to the sinuous elongate form seen at Low Water Lake. One of these pits (Feature 1) is 45 x 60 cm in plan and extends to c. 30 cm below the living floor. Another pit (Feature 2) is 25 - 30 cm in plan and extends to a depth of 13 - 15 cm. Both features contain burned and unburned bone fragments, chipping detritus, and occasional pieces of fire-broken rock in a matrix of very dark mixture of charcoal and sand. Charcoal and charred wood were concentrated in the bottom of Feature 1. No internal stratification was observed in either pit.

The variety of contents in these features suggests multiple use activities. The presence of charcoal and burned bone indicates cooking or roasting of meat and/or other foods while the inclusion of fire-broken rock suggests boiling of foods or bone. These two activities could have been simultaneous. The presence of chipping detritus in the pits may suggest that the pits were used in preheat treatment of lithic materials for subsequent tool manufacture; or the detritus may simply have been discarded there. These contents collectively suggest at least three activities related to the use of the pit features. It is obviously too simplistic to suggest that these features are the result of a single function activity (cf. Sims 1974).

Units in Trench B (B/1, B/2, B/3, B/4) (Fig. 21), contained few lithic tools of any kind. Activities concerning stone technology appear related to knapping. For example, 15 cores of various types were recovered from this unit while only five retouched flakes, 11 utilized flakes and three tools (a biface, hammerstone, and projectile point) were associated. In units of Trench C (C/1, C/2, C/3, C/4), lithic materials are also dominated by the recovery of seven cores as opposed to three retouched flakes, four utilized flakes, and one tool (a biface). Chipping detritus is common throughout the surface of the living floor, often occurring in small concentrations. Pebble cores of petrified wood are the predominant type. This material is locally available in glacial till deposits as is a variety of cherts and quartzites also present in the assemblage.

Materials recovered from Test Pits 1, 2 and 3 (Fig. 21) are also predominantly derived from the manufacture of stone implements. Test Pit 1, for example, contained three cores, four retouched flakes, six utilized flakes, and two tools (a uniface and a biface). Test Pit 2 contained one core and two utilized flakes while Test Pit 3 contained large quantities of chipping detritus as did both of the other units. Again, the lithic materials present, i.e., chert, quartzite, and petrified wood, are all locally available in till deposits or stream gravels derived from them.

No samples for radio metric analyses were submitted for this single component site owing to the general lack of diagnostic material. While the presence of two Hanna type projectile points (McKean Complex) collected from the nearby cultivated area may suggest a time range of 2,000 to 2,500 B.C., no firm association of these artifacts with the buried component is possible.

Summary-Discussion

There are three aspects of the content and/or treatment of faunal material which are held in common among all three archaeological sites: (1) each site contains the remains of bison in numbers ranging from one at the Scheideman site to seven in Level 2 of the Cormie Ranch site; (2) each site contains the remains of at least one moose; (3) bone boiling, as evidence by the condition of the bone and/or by the presence of the actual pit profile, was a common manner in which additional fat and grease was obtained from the remains of large mammals.

Beyond these three simple attributes, the assemblages vary considerably with respect to both the number and variety of animal food resources present (Table 12). The differences shown by these faunal assemblages may relate solely to seasonal density and abundance parameters as observed in both the historic subsistence reconstruction (Chapter I) and recent behavioural studies (Chapter II). Cultural preference could also be responsible for the observed variety and this is a question which must receive careful scrutiny. The remarkable continuity with respect to certain animal processing techniques observed in this study (e.g., bone boiling), tends to dimidiate the existence of marked cultural differences concerning the acquisition and use of large game resources. Given the data at hand, the question of seasonal variation as opposed to culturally derived dietary preferences may be much more easily dealt with at least in the initial stages of this enquiry.

At the Cormie Ranch Site, Level 1 contained the remains of one Wapiti which by itself does not document anything more than its mere presence. According to the historic subsistence model, this animal is more likely to have been taken during October through December, but to suggest that this is the case at the site without independent seasonal indicators is not possible. Characteristics of antler development, if such were present, might provide the necessary information.

The remains of bison, exclusive of all other animal

Table 12

Major Characteristics of Three Archaeological Sites and Probable Season of Occupation

Site/ Component	Species Present (Number of Individuals)										Hearth Type	Boiling Pits	Lithic Type(s)	Site Type and Age	No. of Stone Projectiles	Probable Season of Use
	Bison	Wapiti	Moose	Deer	Fox	Beaver	Muskrat	Hare	Skunk	Canis spp.						
Cormie Ranch Site (Level 1)		1									shallow-irregular	Absent	Local	Open Camp A.D. 855 ± 130	(1)	October-December
(Level 2)	7										shallow-irregular	Present	Local & Exotic	Pound Processing A.D. 605 ± 61	(12)	December-February
(Level 3)	3										shallow-irregular	Absent	Local	Pound(?) Processing 2050 B.C. ± 120	(8)	December-February
Low Water Lake Site	2	1	1	1	1	3	6	3	1	1	deep-elongate	Absent but Probable	Local	Open Camp A.D. 580 ± 80	(8)	c October
Scheideman Site	1		1		1						ephemeral and deep ovoid	Absent	Local	Open Camp N.A.	(2)	August-November

species contained in Level 2 of the site, would seem to fit the historic pattern of late winter (December through March) hunting in the transition zone. Lack of fetal material suggests that the season of occupation must post-date spring calving (April through May) and pre-date the development of archaeologically durable fetal bone (December through February).

A minimum count of individual bison in Level 2 indicates the presence of at least seven animals. Since an estimated 40 percent of the site has been destroyed perhaps as many as 12 animals may originally have been present. Initially the kill method was interpreted as a "mire-drive" (Losey 1972:22), although no direct evidence to support this is available. Also, it was thought (ibid.:24) that the season of occupation could not have been later than November since frozen ground would preclude the presence of sub-surface boiling pits. In retrospect, the limitations imposed by frozen ground in this respect may not be valid. For example, the presence of charcoal in the bottom of several of the boiling pits could be the result of intentional thawing of frozen ground by fire for the placement of these features. Furthermore, the frost depth varies considerably depending upon the time, depth, and duration of snowfall. The presence of frozen ground would, however, eliminate the possible use of a mire-trap as originally suggested (ibid.:22).

No unequivocal evidence for the season of occupation at the A.D. 605 level of the Cormie Ranch Site exists, but one tangible clue to the possible alignment with the historical parklands wintering practice is the presence of an obsidian artifact, the source of which is Yellowstone Park, Wyoming (E. Nelson personal communication). The piece is a medial flake fragment showing usewear on the transverse edges and light retouch along one lateral margin. Whether this specimen is the remnant of material traded for by a local group, or a tool actually transported by an extralocal group having direct access to the source is difficult to determine. If, however, the item is the result of trade networks which included access to materials as exotic as this obsidian appears to be, one would expect it to be fairly common throughout the parkland region. In fact, it is not.

Nevertheless, this is slim and circumstantial evidence upon which to suggest a late winter occupation by northern plains buffalo hunters as was commonly observed during the historic period. The relatively large number of animals present, however, does argue strongly for the use of a pound or trap. The presence of all skeletal elements suggests that the kill was close at hand, and historic documentation indicates that pounding was the commonly preferred method of late winter bison procurement.

The faunal material recovered from Level 3 again presents the barest skeletal framework within which to propose seasonal interpretation. A minimum of three bison are present but again no fetal remains were encountered. Poor preservation may have resulted in the disappearance of such remains had they been present.

Boiling pits are either non-existent or were not found, but bone boiling was apparently practiced. Lack of independent seasonally diagnostic materials precludes interpretation with any certainty.

Faunal remains recovered from the Low Water Lake site present a more reliable picture. There are three mammalian species which, because of their mutual seasonal availability, suggest a late fall occupation. These are bison, moose, and Wapiti which, according to the Edmonton House records (Fig. 16), would most likely co-occur in October. The small number of bison present (N = 2) suggests that these represent isolated kills which are typical of the late fall, pre-migration period when only small numbers would be available.

Additional support is lent by the presence of waterfowl which would be available in relatively large numbers in October as groups congregated at major staging areas for the fall migration. This aspect of waterfowl behaviour does not seem to have been important in the Edmonton House subsistence pattern perhaps due to the lack of major staging areas within hunting range of that establishment. Low Water Lake was an important staging area for waterfowl using the Mississippi and Central flyways prior to 1925 (Anon. 1969; J. Jouan personal communication).

Aquatic rodents such as muskrat and beaver if desired for their pelts or for food would be in prime condition in late fall. Fall fishing is also a common activity according to the historic reconstruction. The remains of fish, however, are rare;

being represented by two centra. This may well be due to processing methods used when drying fish wherein the skeleton is stripped of its flesh which is then dried for future use. It may be that fish were not used extensively since so many other animal resources were apparently available.

Hare are available year around. Their density is determined more by the phase of the population cycle than by differential seasonal availability. The same is true of the canidae cycle which is directly linked to that of the hare and other rodents. Neither of these animals appear to have been very important contributors to the human diet at this site.

The remains of eggshell are enigmatic. Their presence, if related to site occupation, would preclude the late fall habitation interpretation. As stated previously, there is no direct evidence that the eggshells were present as a result of cultural activity. Predation by indigenous animals, that is, skunks, canids, and predatory birds, may be responsible for their inclusion in the assemblage.

The intra-site distribution of large mammal remains, that is, bison, moose, and Wapiti, is perhaps of some interest. Bison, for example, is represented by a more or less complete inventory of skeletal elements including most of the axial member. This suggests that the two bison were taken nearby and that few, if any, portions were left behind due to energy considerations. It is possible that the bison pound (?) operated during the occupation of Level 2 of the Cormie Ranch Site and the small island encampment were occupied by the same group and that the island location was inhabited during preparation of the pound to be used later in the year. The two sites are less than one-half mile distant.

Wapiti are represented only by elements of the pectoral limbs and moose by elements of the right pelvic limb and a right carpal bone. This suggests that these animals were processed and/or partially consumed at some location other than the island encampment. However, it would not be prudent to place too much weight on this interpretation since the absence of some of these skeletal elements could be due to incomplete sampling.

A late fall occupation at the Scheideman Site can be postulated on the basis of co-occurring bison (N = 1) and moose (N = 1) remains. In the absence of other species, however, the duration of occupation should be extended to include August through November as these two animals, according to the historic model, co-occur throughout this period.

Scanty remains of bison representing a right pectoral limb and an indeterminant pelvic limb suggests that butchering units were transported to the site and that the lower limbs (pedal bones), cranium, and vertebral column were left behind. The presence of two lower molars may indicate that the mandible was retrieved perhaps as a carrying device for the tongue (cf. White 1955).

The very sparse remains of moose (consisting of a phalanx and a vertebral fragment) defy interpretation. Bone elements representing the left forelimb of fox are probably also the remains of a meal. Canids, particularly dogs, were often served for religious and other special occasions by many Northern Plains groups as well as others (Ewers 1955:162,222; Prahl 1967).

CHAPTER V

PROVISIONAL TEST OF THE MODELS

Introduction

To review the inventory of wildlife habits and habitats here would be redundant. The value of these data lies primarily in determining whether or not the historic and ethnohistoric reconstruction of subsistence patterns and practices bear any real relationship to animal behaviour and seasonal availability. The Edmonton House game records provide important data on seasonal behaviour and density patterns of the animals hunted by prehistoric occupants of the ecotone. If the record is accepted as the product of seasonal game abundance, then animal behaviour in itself becomes a powerful tool for archaeological interpretation. At its worst, it can provide a 'best estimate', in the absence of independent evidence, for determining the seasonality of an archaeological site. At best, it provides corroborative evidence for seasonal occupation and resource exploitation.

Seasonal game abundance and concomitant subsistence strategies among aboriginal populations who exploited transition zone resources plays a crucial role in modelling an hypothesis which accommodates the data. That Plains Indians did inhabit and exploit the transition zone yearly in late-winter (at least historically) is one of the most salient historical facts to be accounted for in any ecological explanation. Of itself, the annual pattern of bison procurement supports the notion that late winter was a crucial survival period for human populations (see for example, Henry 1809:272 passim; Hearne 1971:80; Mackenzie 1801:cxxvii). Without access to their winter range and the bison, Plains Indian population dynamics would have been quite different and survival certainly more precarious.

In spite of the well documented exploitation of the transition zone for bison, it seems inconceivable that the ecotone would remain uninhabited through the duration of the year, or that it was not accessible by human groups originating other than on the plains. Hickerson's (1962) study of Chippewa-Dakota interaction along the deciduous forest buffer zone provides many insights into potential interplay among northern Plains groups and mixed-wood forest Athabascans. Although not explicit, exploitation of the deciduous forest ecotone in Minnesota was most important in late winter when yarding deer were vulnerable and provided a critical resource item analogous to the use of wintering bison in the western prairie-forest transition.

It is virtually impossible to document exploitation of the transition zone by mixed-wood forest Indians due to a lack of records and the mass displacement of aboriginal inhabitants at an early date. It seems clear, however, that the original occupants were Athabascans and perhaps the Beaver Indians. The only historical evidence really suggestive of Athabascan exploitation of the ecotone lies in their knowledge of Plains bison behaviour as expressed in their ability to erect and operate bison pounds. The practice of summer pounding among the Sarsi may be a remnant of an earlier subsistence practice which still had utility in the shift to a more plains-like subsistence pattern. As far as ethnohistory is concerned, the presence of Athabascans as partners with plains groups in exploiting the ecotone is largely circumstantial.

The ability to separate plains from forest affiliated archaeological sites on the basis of the remains of their respective technologies presents a major obstacle, so far as this and all other studies are concerned. At present, perhaps because the sample is small, there is little with which to discuss any major differences. Two attributes, however, may lead to the establishment of certain diagnostic criteria. These are (1) the presence or absence of projectile points, and (2) the morphology of hearths and boiling pits.

For example, the subject of projectile points continues to plague workers in the forested regions of northwestern Canada. A well established typology of time-diagnostic projectile point styles has been developed (_cf_. Reeves 1970; Wormington and Forbis 1965) which facilitates identification of cultural affiliation in plains archaeological sites. However, this is not so in the forest zone since characteristically, forest dwelling Athabascans favored a technology that relied heavily on organic materials and on traps and deadfalls as opposed to projectiles. In other words, the basic lack of stone projectile points in Athabascan sites is perhaps one of their most salient characteristics.

The possibility that hearth and cooking or boiling pit configurations may differ between forest and plains dwellers also has merit. Athabascan hearths are often elongate (av. 66 cm by 123 cm) (cf. Cinq-Mars 1974:B16; Minni 1976:130-34) reflecting the use of long sticks and small timber laid parallel and fed into the fire from each end. Such a practice may be traditional and may reflect a specific arrangement of both people and cooking utensils as related to the use of this hearth type. It should be added that the linear hearth arrangement may be inappropriate in a circular plains tipi dwelling which commonly has a stone-lined circular hearth configuration. There is the possibility that hearth morphology may be disparate between an open as opposed to a confined (as in a dwelling) situation.

There are other aspects of material culture that may prove useful in determining which, if any, of the proposed models can be fulfilled. The presence of materials exotic to the transition zone should prove a useful tool in tracing the origins of a given site assemblage and its occupants. This is especially true of sites occupied in winter when, because of snow cover, its occupants would have limited access to most stone sources and would, therefore, probably have on hand whatever tools they required for winter subsistence activities. The possibility for trade in exotic materials is, of course, always present and could be an indicator of group interaction within or beyond the ecotone.

Human populations present in the ecotone prior to winter and continuous snow cover would have the option of exploiting local materials for tool making. What, if any, strictly "local" stone sources existed in the western prairie-forest ecotone have yet to be determined. Similarly, the search for diagnostic tools or traits among the adjacent prehistoric Athabascan populations is yet largely undeveloped. Recently initiated research in the southern boreal forest will hopefully shed light on this problem. On the other hand, the preservation within Athabascan sites, particularly of organic materials, may be superior in the transition zone, owing to less acidic soils.

Artifacts that are both time-diagnostic and culture-specific are well enough known to permit a fairly straight forward identification of plains affiliated sites in the transition zone. Establishing the season of occupation is a separate but not insurmountable problem. It is obvious, however, that many utilitarian tools made of stone do not differ substantially from their counterparts in forest cultures. Often this similarity stems from the use of stone material types of ubiquitous origin. The fracture dynamics of widespread material types such as quartzite may be responsible for the marked similarity in the morphology of certain artifacts, in relation to their similar functions.

Clearly the greatest problem for future research with respect to the model presented here will be the unquestionable identification and seasonal allocation of sites belonging to an Athabascan or other forest dwelling population. With a few exceptions, these sites are best characterized as materially impoverished (i.e., as regards their archaeological visibility (Deetz 1968)). This trait is not due to any lack of cultural elaboration but rather a heavy dependence on perishable materials which often leave little archaeological impression.

Interpretation

Frontier Zone Hypothesis

Statement:

> The prairie-forest ecotone functioned as a frontier zone/no-man's land which served to separate two or more adjacent cultural groups during some specified time period.

There is hardly enough archaeological data originating from the transition zone to provide an adequate test of the first model or Frontier Zone Hypothesis. The fact that some data does exist for portions of the middle- and late-prehistoric periods argues against the applicability of this model, at least for those time periods. It would be premature to suggest that for the balance of prehistory in the area, the ecotone functioned as an uninhabited zone owing to the present lack of archaeological information.

The Frontier Zone hypothesis embodies many factors that might be considered causal in the absence of archaeological remains for a given time period. One explanation might be dramatic climatic shifts and ensuing resource fluctuations or depletion (*cf*. Wedel 1961). Others may be cultural or psychological in nature. The following provisional test of the model will illustrate their potential application.

Prediction 1:

> The existence of a frontier zone, uninhabited by any human population, will exhibit no archaeological remains for the period during which it continued to function as such.

Since fulfillment of this prediction calls for the use of 'negative evidence', it should be applied with some measure of caution. This is especially true in the transition zone since the present lack of archaeological data is perhaps more a product of limited research than actual absence of prehistoric human populations. That is to say, it would be premature to accept this prediction as verified in the absence of a more complete temporal prehistoric framework.

It is clear from the data at hand that human populations did utilize the ecotone during portions of the middle prehistoric (2,500 B.C. to A.D. 600) and late prehistoric (A.D. 600 to c A.D. 1750) time periods. There are gaps in the time frame which may or may not be filled by data forthcoming. This is particularly true of the early prehistoric period preceding 2,500 B.C. to c 7,000 to 9,000 B.C. Carbon 14 dates obtained from sites in the Low Water Lake area of approximately 2,500 B.C., A.D. 580, A.D. 605, and A.D. 855 suggest that a Frontier Zone condition did not exist during the early middle- and early late-prehistoric periods. Many of the gaps in the late period can be tentatively filled by artifacts dated typologically.

Prediction 2:

> Enquiry into the causal factors responsible for the avoidance of a given area by a human population will reveal that one or more of the following elements was operative:

a) The region became uninhabited due to physical changes in the environment, e.g., glaciation, subsidence, climatic deterioration, overexploitation etc.

b) The region became uninhabited due to cultural/psychological reasons, e.g., mutual fear and distrust, to avoid aggressive conflict, blood feud, suspicion of magical influence, witchery, etc.

Two inferences outlined above have been placed within two separate classes; one physical, the other cultural. As was previously discussed in Chapter III, the former class of phenomena is much more amenable to enquiry and testing than the latter. Although abandonment of the ecotone due to any number of physical factors, is both feasible and susceptible to scientific discovery, there is little cause to belabor the utility of this prediction in explaining the apparent absence of archaeological data for the periods previously indicated. Suffice to say that, other than a possible climatic deterioration during early Altithermal times (c 6,000 to 3,000 B.C.), there is no reason to suspect the existence of a frontier zone given the premature nature of both archaeological and paleoenvironmental studies in the Western Transition Zone. Moreover, it has recently been argued (Reeves 1973) that climatic fluctuations related to the Altithermal had minimal effects on the Northwestern Plains region.

The class of cultural and psychological factors which could create an uninhabited frontier zone have no more relevance to the data at hand than do the physical explanations, and for the same reasons. That is not to say that they will not perhaps be relevant at a future date, but in summary, the data do not support the requirements of either of the two predictions following from the Frontier Zone hypothesis.

Lack of archaeological and paleoenvironmental data in the ecotone at the present time may be more apparent than real. Research will have to be much further advanced before a cultural hiatus for example, can be distinguished from a sampling error. There is ample reference to use of the ecotone by wintering plains bison hunters to eliminate the Frontier Zone hypothesis as an explanation of late prehistoric human exploitation. However, the model should be retained for possible application to other time periods.

Buffer Zone Hypothesis

Statement:

> Two discrete cultural groups exploited the prairie-forest ecotone on a sporadic and temporary basis only as the need to acquire its resources dictated, the "need" being sufficiently urgent to reconcile the dangers inherent in doing so.

The suggested Buffer Zone Hypothesis, similarly, cannot be fully dealt with simply in terms of the small sample size. However, some preliminary observations with respect to the predictions which follow from this model can be made.

Prediction 1:

> The distribution of archaeological remains in the ecotone is relatively sparse as compared to the content of adjacent regions.

Archaeological sites are not as a whole relatively sparse as compared to adjacent ecozones. Some very cursory statistical measures of transition zone vs. mixed-wood forest site density (Losey *et al.* 1975) indicates that sites in the ecotone are nearly four times as numerous as in the forest. Prediction #1, therefore, is not fulfilled.

Prediction 2:

> Sites in the ecotone are commonly fortified or occupy strategic topographic positions as to increase visibility as a safety factor against discovery by a rival group.

None of the data presented in this study nor, to the writer's knowledge, any other observed in the ecotone, suggest the existence of fortified sites *per se*. Many sites, however, do occupy seemingly strategic locations with respect to height and the view commanded from them. Unfortunately, many sites so positioned are poorly preserved and/or deflated making detailed interpretation difficult. Fortification constructed of stone could be expected to preserve but, in the absence of this, it would be speculative to interpret sites located on topographic eminences as being related to war-like activities. For example, similar locations might provide very useful observation points for bands of hunters.

Prediction 3:

> Site contents suggest male dominated activities, i.e., hunting, war.

None of the data obtained from the three archaeological sites discussed above can be said to be strictly male dominated although male activities are certainly represented. If it can be assumed that most, if not all, big game resource procurement was a predominantly male activity, then all three sites and their components are indicative of male presence owing to the presence of large mammalian fauna, e.g., moose, bison, Wapiti, etc. Large scale stone tool manufacture is no doubt also largely a male dominated activity but does not rule out a female component, as for example, rejuvenation of a knife or scraper edge during use.

Be that as it may, all of the sites excavated also possess evidence of female tasks performed on the sites. For example, the presence of stone scrapers and knives indicate hide working, skinning and butchering which historically almost invariably fell to the women (cf. MacKenzie 1801:xcviii; Hearne 1971:336). Similarly, numerous hearth or roasting pit features or bone boiling pits, associated with culinary activities, are also viewed as remnants of female tasks.

Prediction 4:

> Cultural remains in these sites are not abundant owing to the transient nature of the occupants.

It cannot be said that cultural remains are characteristically scanty although there does exist a large number of very small sites having relatively few material remains but, for the most part, these await detailed and systematic interpretation. With the possible exception of the Scheideman Site, most of the sites discussed here can be labelled as "transient". The Scheideman Site is obviously only a small portion of a larger, relatively rich site most of which has been destroyed by agricultural activity.

Alternate-Seasonal Exploitation Hypothesis

Statement:

> Two or more discrete cultural groups exploited the ecotone during some given time period. Annual exploitation by each group was based upon alternating seasonal incursions for the utilization of some specific set of resources.

Consideration of the Alternate-Seasonal Exploitation Hypothesis is necessarily much more complex than either of the preceeding models and requires examination of relevant historic records as well. This model requires that two or more discrete cultural groups be identified as part-time occupants of the ecotone for the purpose of extracting some seasonally (?) available resource.

Prediction 1:

> Archaeological remains recovered from sites in the ecotone are sufficiently similar to remains from adjacent regions to define definite cultural affiliation.
>
> -OR-
>
> There is sufficient similarity between archaeological remains and historically described cultural practices to warrant the tentative identification of a discrete culture (or cultures).

The movement of plains groups into the parkland zone in the wake of migrating bison herds in late winter is a well documented occurrence. For the Blackfoot Indians, this pattern of winter existence can be considered traditional. For the Assiniboine and Cree immigres, the apparent stability of the bison as a winter resource was too good to ignore. That the operation of a successful buffalo pound was a great temptation for all groups having access to the wintering grounds is amply documented by the disgruntled fur trader. The existence of this very highly developed technique for procurement of bison coupled with its elaborate socio-religious aspects may be evidence for its antiquity.

Whether or not other groups residing near the ecotone made seasonal use of its many resources has no historical support. However, the fact that both the Beaver and Sarsi Indians were familiar enough with bison behaviour to erect and successfully operate buffalo pounds could be indicative of a previous familiarity with the transition zone bison population. Whether or not these Athabascan groups would have chosen to exploit wintering bison herds as did the Plains Indians is questionable. It is interesting in this regard to note that the Sarsi were apparently the only plains group that practiced summer buffalo pounding (Jenness 1938:17).

It may be that bison herds overwintering in the transition zone did not have the same attraction for mixed-wood forest Athabascans as for certain Plains Indians. For example, forest hunters using snowshoes are more apt to successfully track and overtake large animals such as moose, deer or Wapiti during late winter when crusted snow conditions impede the movement of these animals. In addition, Wapiti and deer are subject to yarding behaviour during this period which results in areas of local abundance.

There are, however, other resources which become available in late summer such as various wild fruits and, of course, a large influx of migratory waterfowl which are both nesting and flightless during this season. Alexander Henry (1897:291) for example, records the Indian's summer harvest of moulting ducks and their eggs by the "canoe loads". McDougall (1971:98) notes a Native technique for steaming eggs in a bark cylinder. The infrequent mention of this resource in fur trade journals is probably the result of the trader's absence from the Saskatchewan River posts in summer.

If forest dwelling Native groups relied to any extent upon waterfowl resources, they might well have exploited the aquatic environs of the transition zone. The density of nesting migratory waterfowl is directly linked with spring water levels in sloughs and ponds throughout the prairies. It is interesting that when a shortage or decrease of nesting sites occurs, waterfowl in excess of nesting capacity will overfly the prairie wetlands and seek sites in the southern forest region. Thus, during years of less abundant waterfowl in the prairie region, there is a relative abundance in the forest lakes and ponds. The Athabascans had a well developed trap and snare technology for procuring these birds (Hearne 1971:275-76).

There is ample ecological evidence that the transition zone is a potentially highly productive ecosystem during the late summer-early fall seasons but there is no historical evidence to indicate which, if any, Native group exploited the ecotone during this period. So far as the historical record is concerned, there is only the potential for alternate season use by different human groups. The hiatus in the record may be due to the early de-population of the southern forest zone by the indigenous Athabascans.

The archaeological evidence recovered from the Cormie Ranch, Low Water Lake, and Scheideman Sites suggests the presence of human groups originating from two cultural traditions, i.e., plains and mixed-wood forest adapted populations. The plains cultural adaptation is exemplified by Levels 2 and 3 of the Cormie Ranch Site. The faunal assemblages are exclusively bison and the suggested winter occupation, based in part on the lack of fetal bison bone, conforms quite well with the plains pattern of winter bison procurement.

The bone boiling pit features in Level 2 find no equivalent counterpart in either the Low Water Lake or Scheideman Sites. And, although largely unassignable typologically, projectile points are also more frequent (see Table 12). Hearth form is difficult to describe as all are shallow, irregular scatters of carbonaceous residue with dense pockets of calcined bone fragments; very unlike the deep, elongate hearth pits at the Low Water Lake Site.

Tentative assignment of an Athabascan origin for the Low Water Lake and Scheideman Sites is based on several lines of evidence, some of which are circumstantial, and some subject to sampling error. The connection between the use of long firewood and the Athabascan elongate hearths has already been discussed and needs no further elaboration. The hearth configuration at Low Water Lake Site is a seemingly obvious archaeological example of this hearth type. With one exception, those at the Scheideman Site do not conform as well to the type but neither are they similar to those at the Cormie Ranch Site.

The presence of moose and, particularly, fish and beaver argue against a plains origin for the Scheideman and Low Water Lake Sites owing to the traditional abhorrence of these animals as food among the Plains Indians (see for example, Nelson 1973:171). Finally, the relative scarcity, particularly at the Scheideman Site, of projectile points is supportive of the Athabascan origin. This evidence is, of course, subject to sampling error.

The second condition predicted by the Alternate-Seasonal Exploitation model is that significant quantities of cultural material (e.g., stone) have exotic origins. In terms of the archaeological contents of the three sites discussed, the lithic assemblages are perhaps the only material source present which is sensitive to the required analysis. Unfortunately, a large proportion of the lithic material is comprised of quartzitic stone which is widespread in Alberta. Other materials such as a variety of cherts are also available in the stream gravels throughout the Northwestern Plains and southern forested regions.

Prediction 2:

> A significant quantity of cultural remains (e.g., stone), have exotic origins, i.e., in localities away from the transition zone.

Only one artifact fulfills the requirements of this prediction and that is a single piece made of black obsidian which has its origin in the Yellowstone Park region of Wyoming (Nelson 1975 personal communication) and was recovered from the Cormie Ranch Site. This evidence, however, should be viewed with caution as it might also be the result of trade.

Prediction 3:

> Faunal remains by virtue of observed biological or inferred behavioural parameters indicate that occupation of any given group was seasonal.

The evidence of seasonal occupation for each of the three sites has already been discussed (Chapter IV) but by way of summary, the Cormie Ranch Site (Levels 2 and 3) are most likely winter occupations related to seasonal bison procurement techniques practiced by historic Plains Indians. The Low Water Lake Site is interpreted as a late summer to late fall camp or habitation, and the Scheideman Site an early to late fall occupation.

Prediction 4:

> Examination of inferred seasonal exploitation patterns indicates that no two groups inhabited the ecotone simultaneously, i.e., occupation was alternating.

It seems apparent, if the seasonal interpretations are accepted, that the Low Water Lake and Scheideman Sites were occupied from one to three months earlier than was the Cormie Ranch Site. Thus, Prediction #4 is partially fulfilled.

Exclusive Ecotonal Exploitation Hypothesis

Statement:

> Archaeological remains, i.e., artifacts, features, subsistence-settlement systems, pertaining to sites in the ecotone indicate that the prehistoric inhabitants were exclusively adapted to year-round utilization of transition zone resources for the time period indicated by those remains.

The predictions which are generated by this hypothesis call for a demonstration through the use of archaeological, ecological, and/or historical data, that aboriginal occupation in the ecotone was exclusive of outside cultural groups and was annually continuous. The presence of archaeological materials, features, structures, etc., exotic to the transition zone are viewed as the products of trade or minor cultural influences, as opposed to actual occupation by groups originating from adjacent ecozones. The classes of information required to test this Exclusive Use hypothesis do exist in the present data base, albeit somewhat scanty in certain instances. However, a provisional test of the model does not generally support the predictions generated.

Prediction 1:

> Archaeological remains recovered from sites in the ecotone are sufficiently dis-similar from remains found in adjacent regions to define an exclusive cultural adaptation to ecotonal resources.
>
> -OR-
>
> There is sufficient similarity between archaeological remains and historically documented cultural practices pertaining to the ecotone to identify an exclusive cultural adaptation and occupation.

As was previously indicated, there is a considerable gap in historical records with respect to human utilization of the transition zone, the winter exploitation by Plains Indians being the only well-documented pattern. However, the Sarsi Indians are perhaps the only known historical group that could conceivably have exploited part of the ecotone on a permanent basis. It has been shown that by A.D. 1700 to 1750 the Sarsi had already separated from the parent Athabascan stock. However, whether this division was the result of an internal (i.e., Athabascan) readaptation, or of the Assiniboine-Cree infiltration is difficult to interpret. The rapidity with which the Sarsi moved into the plains and became a functioning part of the great Blackfoot Confederacy could be indicative of their familiarity with the plains environment owing to their proximity to the ecotone.

There are, however, two lines of evidence to the contrary that require examination; one is historical, the other ecological. The first centers around the apparent freedom with which the Assiniboine were able to penetrate westward along the North Saskatchewan River axis (Ray 1971). It would seem strange that no mention of encounters with resident Native groups were recorded prior to their reaching the headwaters region between the North Saskatchewan and Athabasca River (bordering the extreme west edge of the ecotone) which David Thompson cited as the Sarsi homeland. This unencumbered movement is reminiscent of the Menominee penetration through the Chippewa-Dakota buffer zone described by Hickerson (1962) which was an unoccupied region except for seasonal resource use by indigenous neighboring groups. A similar pattern may have been followed by the Sarsi.

The ecological implications for long-term, exclusive utilization of ecotonal resources are that such was probably not possible without creating irreparable damage to wildlife breeding populations. Again, Hickerson's (1962, 1965, 1970) work is instructive. From it, it is obvious that the transition zone resident deer population could not withstand continuous exploitation in spite of their large numbers. Over-exploitation prior to European peace-keeping intervention was held in check by both Native groups who were keenly aware that to allow the other unlimited access to the deer resource could mean devastating food shortages for themselves. Subsequent depletion of food and fur resources due to pressures attributed to the European fur trade economy and attempts to create binding peace between the Chippewa and Dakota Sioux, led repeatedly to overkill of the deer and ensuing open warfare (Hickerson 1970:102).

Evidence already discussed with respect to the Alternate-Seasonal Exploitation hypothesis is practically antithetical to that required by the prediction following from the exclusive exploitation model. For example, with regard to Prediction #1, the archaeological data show reasonably strong affinities with plains or forest adapted subsistence strategies as opposed to an exclusive transition zone adaptation.

Prediction 2:

> Cultural materials originating from outside
> the ecotone are present by virtue of trade
> and/or short term occupation of adjacent
> regions for the purpose of resource extraction.

As was suggested previously, the presence of Yellowstone Park obsidian is no stronger evidence for trade than it is for actual transhumance from Wyoming to the transition zone. Verification of this prediction is therefore ambiguous.

Prediction 3:

> Faunal and botanical remains recovered from sites pertaining to the group in question exhibit biological or inferred behavioural characteristics which indicate that occupation of the transition zone was annually continuous.

Faunal and botanical remains do not, as far as the present data are concerned, indicate continuous, year round occupation.

Admittedly, the accumulation of additional archaeological data may in time lend greater support to the Exclusive Use hypothesis, although it is the opinion of the writer that should an exclusive aboriginal occupation be recognized and 'proven', it will, on the basis of the ecological data presented, be a relatively short-term one. The historical data base is not likely to be altered drastically by future discovery of historic records but, an increase in faunal inventories from archaeological sites and the development of a greater understanding of prehistoric trade networks and materials could change the interpretation of occupation patterns in the ecotone.

Diffuse Cultural Transition Hypothesis

Statement:

> Human subsistence-settlement systems as exemplified by archaeological remains in the ecotone represent a continuous blending of material and behavioural complexes defined in regions adjacent the ecotone.

The data base considered adequate to perform a provisional test of this model is largely deficient, particularly as regards the first three of six inferences generated by the above hypothesis. Those inferences are as follows:

Prediction 1:

> Archaeological materials present in the ecotone form an intergrade with respect to known archaeological assemblages assignable to cultures found in regions adjacent the transition zone.

Prediction 2:

> An intermingling of material types, technologies and other durable remains of cultural practices suggest cultural affinities with adjacent human groups; affinities which may be inversely proportional to increasing distance between a site and an adjacent cultural region.

Prediction 3:

> Quantitative or qualitative differences in archaeological assemblages in the ecotone are the result of changing seasonal subsistence strategies and/or group re-alliances which have the effect of making these assemblages appear more or less similar to those of adjacent regions.

Recognition of intergrading or inverse distributional characteristics of archaeological materials, and seasonal changes within those distributions clearly require not only a large sample of transition zone sites, but a large comparative data base derived from adjoining ecosystems. At this point in time, both the transition zone and the southern forest regions are yet to be thoroughly investigated. Recent emphasis respecting the necessity to compile detailed regional site inventories well ahead of land use development in Alberta, will hopefully lead to the collection and interpretation of more complete archaeological data base.

The data discussed concerning seasonal occupation of transition zone sites with regard to previous models can also be applied to Prediction #4 of this model, which states:

> Prediction 4:
>
> Although specific site occupations are expected to be seasonal, they should collectively exhibit continuous annual use within a defined geographical range. Seasonal shifts in subsistence-settlement strategies will be the result of a single broad-spectrum cultural adaptation in which group mobility, and hence archaeological variability, is great.

Certainly there exists ample inter-site variability to be viewed possibly as the result of the expected seasonal shifts. Faunal remains used as seasonal indicators from the three transition zone sites, collectively form a record of occupation extending from late summer through early winter. Site occupations originating in late winter through early summer (a gap of five to six months) have not yet come to light, as they must if this prediction is to be fulfilled. Therefore, either the data are incomplete or they do not conform to the diffuse transition model.

> Prediction 5:
>
> Biological and behavioural parameters observed in faunal and botanical remains will show marked seasonal shifts in subsistence-settlement strategy and will provide some control for the basis of these shifts.

Verification of this inference depends upon the existence of faunal and botanical information to determine the nature of apparent seasonal shifts in settlement pattern vis-a-vis the exploitation of resources seasonally abundant in specific habitat areas, e.g., upland, aquatic, riverine environs. The idea or existence of the seasonal round is implicit in this explanation of the ecotonal subsistence-settlement pattern. Again, however, the data are too fragmentary to be unequivocal.

Prediction 6:

> Resources available only from regions outside the transition zone (if present) will exhibit a decrease in relative abundance proportional to increasing distance from their source.

This inference concerns resources exotic to the ecotone and their projected distribution among its inhabitants. This aspect of material culture does not specifically take into account the results of trade contacts but rather, only those resources which are directly accessible through actual human movement or through kinship ties at the periphery of the ecotone. The relative abundance of such materials is expected to decrease with increasing distance from source areas either by means of attrition through use, or intra-group redistribution. Such materials could conceivably include faunal remains (food resources). Again, the data base is unfortunately meager not only respecting archaeological remains, but also the spatial distribution of many known or suspected material source areas as well.

One of the ways in which an appropriate body of data for testing this model might be assembled is along the lines used by Thomas (1973) in sampling the Reese River region of the desert basin area of Nevada. This procedure entails delimiting a study area of appropriate size and dividing it into a series of sampling strata according to reconstructed vegetation associations (ibid:168). A sampling grid is then projected over the study area and a random sample is taken to ensure that all areas receive some investigation.

This sampling procedure allowed Thomas (ibid:158) to "...test the artifactual outcomes of the Shoshonean seasonal round...[and]... the relationship between artifacts and lifezones". If a similar method was applied to a relatively large tract within the prairie-forest transition zone, not only would the sampling of the complex, mosaic vegetation pattern be enhanced, but the potential recovery of a large body of data would allow a well-controlled internal comparison of sites located in diverse ecological settings. Such a comparison would augment the effort to determine whether sites were the leavings of a single cultural group, multiple groups, or an even more complex system such as proposed in this model.

Obviously, close attention would have to be paid to material remains of every kind including artifacts, features, structural remains and materials utilized if a large scale inter-site comparison was to be successful. Steward (1955:120) stated that the Shoshonean family level of socio-cultural integration was a type of organization unique in cultural evolution. Moreover, he felt (ibid.) that even if other groups had achieved the same cultural configuration, in the evolution of mankind it was "...certainly unprovable...". However, the ethnographic Shoshonean exploitative system has been verified by independent archaeological data (Thomas 1973) and there is no reason to assume that a similar subsistence-settlement pattern cannot be recognized if it existed in other regions.

CHAPTER VI

DISCUSSION AND INFERENCES

The prairie-forest transition zone has been defined as an ecotone which lies as an intermediate vegetation zone between the northern grasslands and southern mixed-wood forest ecosystems. Review of attempts to map the various vegetative components of the transition shows that definite zonation does not exist. The transition is perhaps better perceived as a gradient of species composition at the juncture of two major ecosystems.

Of the various transition zone types, the mosaic ecotone described by Daubenmire (1968) provides the most accurate characterization of the western prairie-forest transition. One of the major characteristics of ecotonal borders has been described by Odum (1971) as the 'edge effect', the observed increase in density and diversity of organisms (both plant and animal) at the junctures between ecosystems (first order ecotone) or communities (second order ecotone). Thus, in the prairie-forest transition zone, a 'maximization' of edge effect has been postulated based on the presence of second order ecotones (cf. Bird 1961) at the juncture between grassland and aspen communities (in addition to the greater density and diversity of organisms as a result of overlap of ecosystems at the juncture).

One of the major features of the transition zone is the implied increase in carrying capacity for organisms which comprise or inhabit the ecotone. A definition of carrying capacity states that it is ". . . the maximum number of animals of a given species and quality that can in a given ecosystem survive through the least favorable environmental conditions occurring within a stated time interval" (Edwards and Fowle 1955:597). For the larger animals, including man, the least favorable conditions in the temperate zone are often present in late winter when energy consumption is maximized due to cold and to scarce food resources.

In the discussion of energy distribution in ecosystems in Chapter II, it was suggested that the production of biomass was highest in the earlier stages of ecological succession. This phenomenon can be expressed as a simple equation which shows the relationship between production and respiration. Horn (1974) has reviewed current thought on the ecology of secondary succession with emphasis on diversity and stability. He suggests that diversity is one of the major characteristics of the prairie-forest transition and that it accrues from two fundamental sources. First, the interdigitation of communities representative of ecosystems flanking the transition will provide a greater variety along a given transect than a similar transect within those ecosystems. Second, disturbance brought about by a number of natural agencies such as fire, animal activity (grazing, browsing, etc.), and climatic fluctuations will, except in very immature ecosystems, allow successional species either to increase if they are rare, or to invade thereby causing an increase in diversity (ibid.:30). In addition, diversity is thought to be greatest in intermediate successional stages as opposed to early or late stages (ibid.:31).

This then may very well be a key mechanism with respect to the relatively greater carrying capacity of the prairie-forest transition compared to the ecosystems flanking it. Maintenance of an intermediate stage of succession will result in optimum pattern diversity which, in turn, results in a high production rate of biomass. Both the variety and numbers of several important animals which can be supported in a given ecosystem must be directly related to the production of green plants. By its very definition, the transition zone is neither a mature (late) nor a pioneer (early) ecosystem. Rather, it forms an intermediate successional stage which is even more resistant to perturbation than the adjacent ecosystems.

The predominance of aspen within the ecotone may be considered a primary indicator of its secondary successional position ecologically. This position is perhaps equivalent to that observed following major disturbances in the mixed-wood forest region where, following the release of energy (such as the removal of light-hoarding coniferous trees), aspen and a variety of secondary successional species invade the newly created site. In the ecotone, however, this stage is more or less continual and results in the creation of a successional tension zone.

The term stability in ecology is typically used as an expression of energy balance; that is, "equilibrium" with respect to production versus consumption (cf. Odum 1971:256). Other workers (Margalef 1970; Holling 1973) have described various kinds of environmental stability which are at variance with the traditional sense of the term. Margalef (1970:11) sees the steady-state kind of stability as relating only to energy balance internal to the system, whereas the ability of an ecosystem to retain its integrity in the face of external interactions is another form of stability that Holling (1973:17) refers to as resilience.

If high production/diversity phenomena, as related to intermediate succession, can be applied to the prairie-forest transition, then the idea of 'resilience' as opposed to 'stability' comes to the fore. This is an important distinction with respect to the transition zone as a reservoir and as a fail-safe resource area as modelled in the Alternate-Seasonal Exploitation hypothesis. Put another way, the transition zone must have a certain resilience if it is to remain a resource area of predictable reliability in spite of changes affecting adjoining forest or prairie ecosystems. One measure of resilience of an ecosystem is the speed with which it returns to its original state following a disturbance (Horn 1974:32). Physical evidence for resistance to change within the prairie-forest tension zone is the inferred spatial broadening of that ecosystem in the face of increasingly frequent disturbance, particularly climatic change. Daubenmire 1968:23) characterized the ecotone controlled by climatic factors as the least immutable citing as proof the relict communities in varying stages of decadence which flank the ecotone.

The suggestion that the prairie-forest ecotone possesses, by virtue of its resistance to external agitation, a high degree of resource reliability and production does not imply in any way its ability to withstand long term human resource utilization without serious major consequences. Hickerson's (1965) study of the Virginia deer as utilized by the Sioux and Chippewa Indians in the deciduous forest "buffer zone" is instructional. There is little doubt that these deer functioned as a critical fail-safe resource for both groups in time of need, but unrestrained exploitation invariably led to depletion of deer below acceptable breeding population levels. There is no reason to assume that game populations in the prairie-forest ecotone would not respond similarly if long term exploitation was maintained.

Confusion in the use of the stability concept has been identified by Holling (1973) who proposes to clarify the issue by distinguishing two interrelated properties of ecosystems: "resilience" and "stability". Resilience is used to define the ability of a system to absorb external changes while preserving its fundamental properties. Stability is simply the ability of a system to return to an equilibrium state following temporary disturbance. The more quickly it returns, the more stable it is.

The relationship of diversity to the notion of resilience is no better understood than that between stability and diversity. Horn (1974), for example, cites studies which have produced contradictory results. He does (ibid:35), however, suggest that resilience (speed of recovery from disturbance) decreases as succession proceeds. There is also the suggestion that resilience and stability may have an inverse relationship (Holling 1973:18) in as much as populations that fluctuate wildly (i.e., are unstable) are also very resilient. In spite of the lack of detailed and rigorous study on this point, there is the hint that "instability" in numbers could result in greater species diversity and "spatial patchiness" and thus increased resilience (ibid:19).

It should be apparent from the foregoing discussion coupled with the results of the provisional test of the models for exploitation of the transition zone that the hypothesis which finds greatest support in the present data base is the Alternate Seasonal Exploitation model. A brief review of the supportive data will serve to summarize its implications. A restatement of the hypothesis will introduce the discussion.

> Two or more discrete cultural groups exploited the ecotone during some given time period. Annual exploitation by each group was based upon alternating seasonal incursion for the utilization of some specific set of resources.

Prediction #1 allowed that recognition of these groups be accomplished using either a direct historical approach and/or through a demonstration using archaeological data that the populations in question originate from regions beyond the transition zone. Both the archaeological and, in part, the historical data base support this first inference.

Prediction #2 calls for archaeological remains, the example used was lithic materials, that also have origins beyond the ecotonal region. Only one sample of stone material which originates from the Yellowstone Park area of Wyoming is present and its occurrence is ambiguous. Analysis of other features, namely hearths, cooking and boiling pits are strongly suggestive of origins among disparate cultural groups. The cultural groups involved are Plains Indians and dwellers of the mixed wood forest region.

Prediction #3 requires that faunal remains recovered from transition zone sites be indicative of seasonal (as opposed to year round) occupation by the prehistoric inhabitants. As was shown, two of the sites described (Scheideman and Low Water Lake sites) were most likely occupied between late summer and late fall while two of the three components (Levels 2 and 3) of the Cormie Ranch Site are most likely late winter occupations. The former group is tentatively given an Athabascan origin, while the latter is assigned to plains dwelling Algonkians (?).

Prediction #4 requires that groups of differing cultural origins occupy the transition zone on an alternating seasonal basis. If the seasonal interpretations forwarded for the archaeological sites are accepted it is apparent that the proposed Athabascan sites were occupied anywhere from one to three months earlier than their Algonkian counterparts. This inference is given further support by the near contemporaneity of the Low Water Lake site and Level 2 of the Cormie Ranch site.

In addition to the archaeological data, the potential for exploitive interplay between two groups occupying regions adjacent to an ecotonal border is given credibility by the somewhat analogous situation described for Chippewa and Dakota in Minnesota and Wisconsin. One basic difference between the model and the Chippewa-Dakota example (Hickerson 1962) lies in the aggressive as opposed to cooperative behavior of groups involved in the latter study.

A fundamental problem in drawing an analogy between the potential exploitation of the western prairie-forest ecotone and the deciduous forest transition zone stems from a complete lack of historical data concerning aboriginal exploitive interactions in the ecotone other than for plains groups. Nevertheless, given the high rate of biomass productivity and 'edge effect' in the transition zone, a wide range of possibilities exist for exploitation of this resource rich ecosystem within easy access to fringe area inhabitants of the northern plains and southern mixed-wood forest.

A review of the literature has shown that the aboriginal inhabitants prior to mass displacement by Cree and their allies were in all likelihood the Athabascan speaking Beaver Indians. A fundamental issue with respect to the alternate-seasonal use model is one of demonstrating what, if any, interaction in terms of ecotonal exploitation had occurred among forest dwelling Athabascans and plains dwelling Algonkians during the past four to five millenia. This issue cannot be resolved by use of ethnohistorical records.

The model is rather open ended with regards to the resources which forest dwelling Athabascans might find attractive. One suggestion was the vast numbers of flightless ducks and the eggs of nesting females in late summer. Others were inferred by the apparent seasonal availability of large mammals suggested by historic Edmonton House game kill records and verified by the review of seasonal behavioral characteristics of those animals. Any number of vegetal products which ripen in mid- to late-summer might also be included.

In summary then, the Alternate-Seasonal Exploitation model states that the resource rich prairie-forest ecotone provided a 'zone of attraction' for both plains and forest dwelling people inhabiting those neighboring ecosystems. Plains Indians used the transition zone as a refuge during the late winter critical survival period in procuring bison. Forest dwelling Athabascans had the option of exploiting alternate game resources during the balance of the year. However, since the critical survival period for most large mammals including man is late winter, Athabascan exploitation could also have coincided with activities related to winter survival.

Conclusions reached in the discussion subsequent to the model formulation indicate that:

(1) Large game animals of the mixed-wood forest were more vulnerable in late winter than in other seasons due to their 'yarding' behaviour which caused local density increases and to the tracking and pursuit advantages provided by snow cover.

(2) Conflict and warfare in the oak-hickory buffer zone was largely an artifact of European influence and a result of depletion of resources in adjacent hinterlands. It is unlikely that this extreme condition would have occurred or persisted aboriginally.

(3) Natural fluctuations in populations of wild animals are not likely to occur in two separate ecosystems simultaneously and thus convergence of two human populations upon the resources of an intermediate transition zone is equally unlikely.

(4) Perennial exploitation of 'resident' animal resources by human predators cannot be tolerated without serious depletion of that resource in the transition zone.

(5) Utilization of transition zone resources by temporarily impoverished human groups is more likely to be peaceful than aggres[illegible]e.

Alternate-seasonal exploitation does not necessarily imply annual exploitation but rather intermittent or temporary exploitation as necessitated by resource failure in an adjacent ecosystem. Similarly, joint use of a single resource by more than one group or for long periods of time is neither necessary or permissible. The transition zone functions as a reservoir of plants and animals and acts as a fail-safe resource base for human populations inhabiting adjacent regions. Exploitation of the ecotone as an alternative would probably not exceed five to six consecutive years since most if not all wildlife population cycles may be reversed in that length of time.

Since hunting conditions with respect to both travel and animal behavior is optimal in the mixed-wood forest during late winter, no conflict between plains and forest dwellers is likely to occur. In addition, a late fall incursion, if necessary, into the transition zone by Athabascans is most likely to take place as a measure in preparation for the late winter survival period.

Although Hickerson's buffer zone model has not been considered directly applicable to the prairie-forest situation, it has offered some insights into potential aboriginal adjustments to a cooperative exploitation of the transition zone. The development of the oak-hickory transition into a contested zone which, if encroached upon by either Chippewa or Dakota hunters, led to conflict and warfare, is largely an artifact of European economic pressure (Hickerson 1970:102). In the absence of economic pressure and an increased reliance on the transition zone resources, it is unlikely that conflict on the scale documented among the Chippewa and Dakota would have resulted. It was, after all, the depletion of food resources in the hinterland due to over-exploitation which gave the deer and the transition zone its special status.

It seems unlikely that such an extreme condition could have evolved aboriginally or that it could have persisted as long. This is not to say that conflict between two aboriginal groups over food resources could not occur, but that whole-sale depletion of those resources would have been far less likely in the absence of the external European economic pressure described here. Natural food shortages could easily cause an aboriginal population to move elsewhere until that resource recovered. If the population occupied a territory adjacent to the resource rich transition zone, temporary forays into that area would probably be the predictable outcome.

A short supply of food can be caused by any number of natural agencies such as fire, a low in the cycle of an animal population, or a short term overspecialized exploitation of an abundant resource (_cf_. Fitzhugh 1972). In any case such a shortage would most likely be a temporary as opposed to a long term one. The need to exploit the ecotone then would also be a short term one, and thus would not necessarily pose a threat either to its resources or to other groups who might also require short term assistance from it. In addition, it would seem unlikely that serious failure of major food resources would occur simultaneously in two ecosystems flanking the ecotone. There is little likelihood that two neighboring human populations would be forced to converge on the transition zone at the same time. Thus, a potential threat to both the resources and to one another would be minimized.

It is far more likely that in the face of a real food shortage, the afflicted population would make whatever forays were necessary to alleviate a pending hardship. Such action might well have to be arranged, at which time justification would perhaps be required by the other group. In fact, a mechanism for avoiding conflict did exist between the Chippewa and Dakota with respect to each other's trapping areas which is described by Hickerson (1970:102) as "tacit respect".

In light of the foregoing, it would seem that the basic model which is most applicable to the western prairie-forest ecotone is "alternate-seasonal exploitation" but with the following adjustments: that seasonal exploitation need not, in fact should not, be considered annual exploitation since such would imply "regular" resource exploitation. As has been shown, this may not be possible without producing an overkill. The exploitation of ecotonal resources is perhaps best viewed as a fail-safe or "cushion" for human populations that normally inhabit the adjacent ecosystems in the face of an impending resource failure. The fact that Plains Indians did apparently occupy the prairie-forest transition on an annual basis need not pose a contradiction. The bison upon which they relied so heavily for winter sustenance were not, strictly speaking, a "resident" population. Thus, no actual removal of transition zone bison took place.

Given the cyclical nature of wildlife populations, it is unlikely that a "crash" of important animal resource populations would affect plains and mixed-wood forest groups simultaneously. The season at which an afflicted group chose to exploit the transition zone would depend largely upon the resource in short supply and when it might be most easily obtained. Nonetheless, late winter is the critical survival period for all animals, including man, in the temperate zone. Therefore movement of a human group into the ecotone might be expected to occur during the stressful late winter period or preparatory to it (i.e., late fall/early winter).

Since many wildlife populations follow a ten-year cycle, any human group suffering from some resource failure might be expected to seasonally exploit a locality within the ecotone for perhaps five to six years. This would be a temporary segment of the normal annual round of subsistence activities that might persist until conditions improved elsewhere. As long as two or more human groups were not in direct competition for the same resource and the same territory, there seems little reason to assume that conflict would arise.

A summary in point form of the inferences drawn from examination of a wide range of archaeological, biological and ecological data and the suggested avenues for research will conclude this initial study of the prehistoric cultural ecology of the Western Canadian prairie-forest transition zone.

Cultural Inferences

(1) Archaeological sites in the western prairie-forest transition zone are of both plains (Algonkian?) and forest (Athabascan?) origin.

(2) Archaeological sites of a forest or Athabascan origin in the ecotone favor a late fall season of occupation when several resources are available, vulnerable, or locally abundant.

(3) Aboriginal exploitation of the prairie-forest ecotone is related to the late winter survival period and is directed toward fulfilling human energy requirements during that critical season.

Ecological Inferences

(1) Archaeological sites in the prairie-forest transition zone of plains origin favor a late winter season of occupation related to the presence of bison on their winter range.

(2) Knowledge and use of seasonal behavior patterns affecting density and abundance of important subsistence animals will greatly enhance seasonal interpretation of archaeological sites.

(3) Seasonal behavior of animals involving the rut, yarding, aggregation, and migration has demonstrably important ramifications regarding vulnerability and availability through changes in local densities and dispersion which are expressed through human subsistence activities and game kill successes.

Avenues of Enquiry

(1) The disparate morphology and configuration of hearths, cooking, and boiling pits between sites of diverse origins may have diagnostic value with respect to distinguishing plains or forest affiliations of sites in the transition zone.

(2) The very content of archaeological faunal assemblages may be of value in determining site origin in the ecotone.

(3) The presence of extra-local or exotic animals and materials in sites located in the transition zone may provide an important and independent aid in establishing site origin and/or cultural affiliations.

That northern Plains Indian groups did exploit the prairie-forest ecotone in late winter is historical fact. Whether or not this practice was part of a long standing seasonal pattern is the question. Conclusive evidence that neighboring groups, such as the mixed-wood forest Athabascans, also had access to the ecotonal resource base as part of a regular seasonal pattern is a matter for further research.

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